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VOL. III.

SURGERY OF THE LARYNX, TONGUE, JAWS, TEETH, SALIVARY GLANDS, NECK, AND CHEST—DISEASES AND SURGERY OF THE EYE AND EAR—SURGICAL DISEASES OF THE SKIN—SURGERY OF THE GENITO-URINARY SYSTEM—SYPHILIS.

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By ROBERT W. TAYLOR, M. D., Clinical Professor of Venereal Diseases, College of Physicians and Surgeons, New York.

back of the mirror to the hand, and it must *never* be introduced into the patient's mouth until this has been done. The temperature should be about 100° F. Having prepared the mirror, let the patient protrude his tongue as far as possible, and carefully enfold the end of it in a clean napkin or handkerchief. Next, seize it between the thumb and fore finger, holding the latter transversely to the long diameter of the tongue. Draw it gently forward and upward, carrying the frænum carefully over the front teeth with the middle finger. Rest the hand upon the patient's chin by means of the three remaining fingers. Cause the patient to open his mouth as widely as possible, and see, finally, that the light is accurately focused upon the pharynx. Then, pass the throat-mirror backward to the uvula, its reflecting surface being directed down-

FIG. 1.

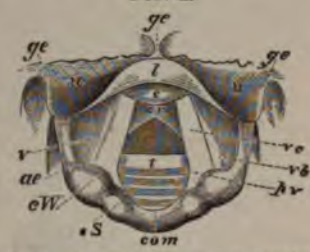
Correct position of laryngeal mirror, with resultant laryngeal image (Seiler).

ward and parallel with the dorsum of the tongue ; insert the mirror under the uvula and push the uvula very gently upward and backward as far as the mirror will go, short of touching the posterior wall of the pharynx with its lower margin. Next, carry the hand which holds the mirror outward until the shank of the instrument rests in the angle of the patient's mouth, support the hand upon the patient's chin, and, finally, tell the patient to phonate the vowel sound "*e*". If all these steps are carried out regularly and in the order given, it will be easy in ordinary cases to see the interior of the larynx.

Having demonstrated the vocal bands in the phonatory position, cause

the patient to take a deep inspiration. This will separate the vocal bands widely, so that the light may be thrown between them and into the trachea, seven or eight rings of which may be brought into view, and even the bifurcation sometimes demonstrated. The different parts which constitute the interior of the larynx should be recognized, and, beginning with the vocal bands, the ventricles, the false vocal bands, the arytenoids, the posterior commissure, the aryteno-epiglottic ligaments, and the epiglottis should be carefully studied. Then the muscular movements of the larynx should be noted, and the parts outside the larynx, the pyriform and glosso-epiglottic sinuses, explored. During the examination the mirror must be held with great steadiness, and care taken not to irritate the patient by keeping it too long in the pharynx.

FIG. 2.



Laryngoscopic diagram showing the vocal cords widely drawn apart, and the position of the various parts above and below the glottis during quiet breathing (Mackenzie): *ge*, glosso-epiglottic folds; *u*, upper surface of epiglottis; *l*, lip or arch of epiglottis; *c*, protuberance of epiglottis; *v*, ventricle of the larynx; *ae*, ary-epiglottic fold; *cW*, cartilage of Wrisberg; *cS*, cartilage of Santorini; *com*, arytenoid commissure; *vc*, vocal cord; *vb*, ventricular band; *pv*, processus vocalis; *cr*, cricoid cartilage; *t*, rings of trachea.

The most common impediments to the successful examination of the larynx are—

1. A short frænum linguæ or a thick, arching tongue;
2. Hyperæsthesia of the pharynx;
3. A long uvula;
4. Large tonsils;
5. An overhanging epiglottis.

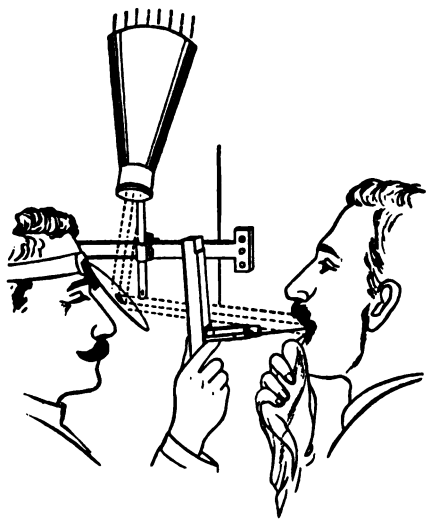
To overcome (1) depress the tongue with the spatula, instead of drawing it forward with a napkin. (2) Cause the patient to swallow quickly a glass of very cold water, let him hold a piece of ice in his mouth for a few minutes, or apply to the velum and pharynx a small amount of a 2 per cent. solution of cocaine. If haste be not essential, direct him to practise several times a day the exercise of touching the throat with some suitable instrument. This will soon render it more tolerant. (3) As a rule, a uvula long enough to interfere with the examination of the throat is sufficiently long to cause irritation, and, if repeated examinations are necessary, it should be amputated. (4) Where the tonsils are so enlarged that a mirror of ordinary size cannot be passed between them without causing the patient to gag, use a smaller mirror. Of course tonsillotomy will greatly simplify matters. (5) This may generally be overcome by causing the patient to phonate with a quick, explosive effort. If necessary, the larynx may be anæsthetized with cocaine and the epiglottis raised with a soft laryngeal probe.

Special difficulties will sometimes arise, which must be met by the exercise of properly directed ingenuity on the part of the examiner.

The art of photographing the larynx, unsuccessfully attempted by others, has been perfected by Dr. T. R. French, who has succeeded also in securing excellent pictures of the bifurcation of the trachea and of the retronasal space. By this method both physiological and pathological conditions may be studied. In taking these photographs French uses either sunlight or electricity and the instantaneous method of exposure,

and is able to photograph any larynx that can be seen by the ordinary method of demonstration in the throat-mirror. The small pictures

FIG. 3.



Photographing the larynx (Cohen).

thus obtained may be enlarged for illustration or for lantern-slide exhibition.

INFLAMMATIONS OF THE LARYNX.

ACUTE CATARRHAL LARYNGITIS.—This affection may be excited by various irritating causes. It may begin in the upper regions of the pharynx or extend to the larynx from below. Sometimes the larynx is attacked primarily. The early symptoms are hoarseness, sometimes chill and fever, and dryness, burning, and general irritation in the throat. Cough is often present. Expectoration appears in the shape of small masses of whitish mucus. Hoarseness may increase rapidly until complete aphonia results. As a rule, there is comparatively little elevation of pulse or temperature.

The common cause is exposure to cold, but over-use of the voice and inhalation or swallowing of irritants may develop it. One attack seems to predispose to others.

Examination shows the interior of the larynx more or less congested. The normal color of the vocal bands is changed from a pale pink to a deep red, and they are apt to be distinctly relaxed, the linear space between them, normally seen on phonation, being altered to an elliptical shape. Sometimes, through swelling of the interarytenoid space, closure of the vocal bands posteriorly is prevented and a triangular opening created, through which, in attempted phonation, the air escapes, resulting in aphonia. Sometimes the attack is limited to some particular region of the larynx. In severe cases submucous extravasation of blood may occur.

Acute laryngitis in children constitutes the disease known as *croup*.

During the day the **symptoms** are hoarseness and a laryngeal cough of peculiar quality. At night these generally grow worse, and dyspnœa may occur, more severe after some time spent in sleep, and due to accumulation of secretion.

The **prognosis** is generally favorable.

Treatment of acute catarrhal laryngitis should be begun as early as possible. Vocal rest should be enjoined, with an even temperature, preferably in bed, cold compresses or ice-bags applied over the larynx, a laxative administered, and, if necessary, a diuretic. The internal exhibition of aconite, of belladonna, or of quinine is often effective, especially the first named. This, like belladonna, should be given in small doses, from a half to a quarter of a minim of the tincture every fifteen minutes for an adult, until a moderate dose of the medicine has been ingested or its premonitory constitutional signs have begun to appear.

For local measures powerful remedies are rarely applicable. The sucking of ice or, later, the inhalation of steam medicated with compound tincture of benzoin, one drachm to the pint, is valuable. In severe cases with distressing cough occasional inhalation of the vapor from a mixture of tincture of opium, one drachm to a pint of water, will prove grateful. Spraying the larynx with a 2 or 3 per cent. solution of cocaine sometimes relieves the symptoms. Warm fluids, such as hot lemonade, flaxseed tea, or equal parts of hot milk and seltzer water, are also useful. Astringent sprays, if used at all, should be applied in very weak solution, one of the best being two grains of sulphate of zinc to an ounce of water, to be repeated four or five times a day. In tracheal inflammation associated with laryngitis great relief will sometimes be obtained by inhalations of a cold atomized 10 per cent. solution of wine of ipecac and water.

Hemorrhage of the Larynx.—In hemorrhage of the larynx the local application of astringents or of styptics may be demanded, while complete vocal rest must be rigidly observed.

Chronic Laryngeal Catarrh.—Chronic catarrh of the larynx is very common. It is most often found in those forced to over-exert the voice under irritating conditions. The inhalation of air charged with irritating matters, the over-use of alcohol, or plethora may contribute to its establishment. It may precede phthisis or malignant disease of the larynx. It often develops from repeated attacks of acute laryngeal catarrh. The most potent factor in producing it is nasal obstruction, by reason of the fact that the air is inspired directly into the larynx without due preparation in having passed through the nose.

The **symptoms** are vocal disability, occasional or permanent and varying greatly in degree, a sense of irritation in the larynx, accompanied sometimes by cough, and a more or less constant inclination to clear the throat.

Examination reveals more or less congestion of the interior of the larynx, hypersecretion, and in certain persistent cases tendency to thickening in various localities. This is apt to be most apparent in the neighborhood of the posterior commissure of the larynx, and it may affect the vocal bands. The congestion may be confined to some particular region, more commonly the posterior part of the vocal bands, which may not be distinctly reddened, but be simply of a dull-gray or grayish-pink color,

relaxed, and apparently thickened. The congestion over the arytenoids, however, and upon the surface of the vocal bands, may be very pronounced. The amount of vocal disability and of secretion present may vary greatly.

The thickening of the vocal bands may cause permanent impairment of the voice, and their free margins, especially over the processus vocali, may also show slight erosions, as may also occur in the posterior commissure.

Paresis of the internal tensors of the vocal bands sometimes is present, although the vocal disability is more often due to thickening of the various parts.

The **prognosis** will depend upon the degree of infiltration and congestion, somewhat upon the duration of the disease, and upon the ability of the patient to submit to the necessary treatment. Residence in a favorable climate, avoidance of vocal fatigue, and proper local and general treatment will usually prove curative if the treatment be carried out sufficiently long. It is very important to recognize whether this disease is simply a local affection or whether it is premonitory or symptomatic of some more serious condition.

The so-called *laryngitis sicca* is a condition of the mucous membrane of the larynx, and also, usually, of the trachea, in which the surface of the membrane is abnormally dry and covered with crusts of inspissated secretion. Virchow has described as *pachydermia laryngis* a condition in which the epithelium has undergone excessive development in certain areas, the result of long-continued catarrhal inflammation. This is said to be unusual except in men addicted to over-use of alcohol.

Trachoma, or *chorditis tuberosa*, described by some as a similar condition and by others as presenting slight differences, is a localized thickening, fibrous in character, upon the surface of the vocal bands. It may occur primarily, although commonly associated with general laryngitis. The thickenings may appear upon the upper surface of the vocal band in the shape of rounded nodules of appreciable size, or as exceedingly fine irregularities located upon the free edge of the vocal band, often bilateral, and in that case apt to be exactly opposite each other, interfering seriously with the vibratory power of the cords. Their existence seriously threatens the tone, quality, and permanency of the voice.

The principles of the **treatment** of chronic laryngitis have been already outlined. Vocal rest, avoidance of all sorts of irritation, including alcohol, tobacco, and highly-spiced food, recognition and treatment of predisposing general conditions, and the careful avoidance of irritating colds, must be enjoined. Hot inhalations are not indicated. Local applications, preferably by means of the spray or the laryngeal brush, should be used. The most effective may be divided into three classes—astringents, resorptives, and stimulants. Inhalations of vaporized (cold) balsamic solutions are often beneficial. In *laryngitis sicca* inhalations of weak solutions of creosote or carbolic acid, followed by inhalations of nebulized oil of vaseline, are beneficial.

The treatment of trachoma of the vocal bands is not satisfactory. In the majority of cases the best results will be gained by rest and the application of astringents if there is any inflammation of the surrounding mucous membrane. If necessary, it has been advised to remove the

nodules by surgical means—exactly in what manner and with what results have never been made quite clear.

Chronic Hypertrophic Laryngitis.—Chronic laryingitis may result in hyperplasia, causing marked thickening of various parts. The region most likely to be affected is that immediately below the vocal bands, and this form is spoken of as *subglottic chronic laryngitis* or as *chorditis vocalis inferior hypertrophica*. Laryngoscopic appearances vary in accordance with the amount of thickening and consequent stenosis of the subglottic region. The prominence is usually somewhat circular in character, bilateral, more or less symmetrical, either gray or pink, and of firm consistence. Sometimes it gives rise to a viscid exudation which produces crusts likely to still further impede respiration. Respiration is interfered with, and sometimes, as the calibre of the trachea decreases, seriously impeded. Occasionally, it is said, spontaneous resolution may take place. As a rule, the disease advances slowly until urgent dyspnœa appears.

The **treatment** must be adapted to the apparent cause of the affection. If specific, iodide of potassium is indicated. The application of iodine externally and internally may also be made. Where dilatation becomes necessary in the subglottic form, the use of the O'Dwyer tube, as in other stenoses of the larynx, is by far the most effective plan of treatment, and should generally do away with more radical surgical means.

Œdematous Laryngitis.—Œdematous laryngitis is a serous, sero-purulent, or purulent infiltration of the submucous cellular tissue of the larynx.

Etiology.—It is most commonly caused by taking cold, following an acute laryngitis, and is, practically speaking, an acute cellulitis. It is more common in men than in women, and usually occurs in early middle life, although occasionally seen in infancy and old age. It is a comparatively rare disease. Secondary phlegmonous laryngitis is much less rare than the preceding affection. It may be caused by almost any one of the acute inflammatory or suppurative affections of the surrounding parts and by iodism. It may occur in the course of typhoid, variola, diphtheria, croup, typhus, or measles. It may be traumatic, from the inhalation of scalding or otherwise irritating vapors, or as the result of swallowing corrosive chemicals, or from the presence of a foreign body. The frequency of its association with erysipelas has often been observed.

The œdema may be situated above, at, or under the glottic aperture. It is generally above and in the aryteno-epiglottic folds and the ventricular bands, which, with the epiglottis, may become so enormously swollen as to lose all semblance to their normal shape and to entirely occlude the larynx. The swelling is usually bilateral, although the contrary is sometimes the case. Unless resolution takes place the infiltration may become sero-purulent, and, later, purulent, resulting in abscess.

Œdema of the larynx may be inflammatory or non-inflammatory, acute or chronic.

The *non-inflammatory* form may occur in the course of cardiac or renal disease; it may be due to pressure upon the large veins in its vicinity and to the continued use of iodide of potassium. The symp-

toms are partial or total loss of voice, dyspnœa, the change of outline of the larynx characteristic of ordinary œdema, and more or less pallor of the surface as compared with the inflammatory form. The treatment must be directed to the general condition, unless dyspnœa be marked, in which case the local application of cold or of cocaine may be employed; scarification may be applied, or, if necessary, an O'Dwyer tube may be inserted in the larynx. The latter method should render tracheotomy unnecessary.

Inflammatory œdema may develop from an attack of acute catarrhal laryngitis or complicate erysipelas of the pharynx. Massei considers the disease erysipelatous from—

1, its rapid development and its tendency to wander, as well as its predilection for parts in which the lymphatics are abundant;

2, the constitutional symptoms, which resemble those of erysipelas;

3, its want of resemblance, from its migratory character, to the ordinary forms of laryngitis;

4, the tendency of the disease to extend to the lungs;

And, 5, finally, its occurrence during the course of epidemics of erysipelas.

He concludes that primary erysipelas of the larynx may exist, and that many cases reported as primary œdema of the larynx are really erysipelatous, this condition occurring more commonly than is generally supposed.

Symptoms.—The chief local symptoms are dyspnœa, aphonia, dysphagia, with, occasionally, cough, and a sensation of marked irritation in the throat. Examination with the laryngoscope reveals intense congestion of the larynx and often of the adjacent parts, with the characteristic swelling of the arytenoids and the epiglottis. The latter may attain such size as to entirely occlude the larynx, and thus produce asphyxia. The false vocal bands are sometimes implicated. The disease may be unilateral, but is more often symmetrical.

Diagnosis depends upon the sudden development of an extensive swelling in certain parts of the larynx of a light-red or translucent grayish appearance, and tending rapidly, in severe cases, to urgent inspiratory dyspnœa.

Treatment must be prompt. In early stages applications of cold in and outside of the larynx, or, if better borne, steaming inhalations (tr. benzoin. co., acid. carbolic. or tr. opii, of either, ʒj–Oij). The administration of a slightly purgative dose of calomel is often valuable. Vocal rest, bed. To relieve temporarily, local applications of a 4 per cent. solution of cocaine. Should œdema become severe, scarification, performed with the concealed laryngeal knife, aided by laryngoscopic demonstration of parts, or with Buck's scarificator. *Following* scarification, application of cocaine to the larynx, as suggested by the writer, for the purpose of constricting the œdematous tissues and, if possible, emptying them. If necessitated by urgency of dyspnœa and absence of other means, quick tracheotomy. In tracheotomizing these startling cases the use of the simplest instruments and methods is permissible, for want of better, as long as the asphyxia is relieved. In the absence of a tracheal cannula the tracheal incision may be kept apart by passing threads through its edges and tying them around the patient's neck. The suc-

cessful experiences of Simpson of New York and others have conclusively proved the value of the O'Dwyer tube in these cases. It is easily introduced in the adult, is quite as effective as tracheotomy, and from its pressure upon the infiltrated parts may actually hasten the departure of the œdema. In suspected laryngeal œdema, therefore, the appliances necessary for intubation should, whenever possible, be kept within easy reach and the patient carefully watched.

Aphonia.

This symptom may be defined as a loss of voice due to some peripheral cause. It may be caused by any functional or organic condition of the vocal bands by which their vibratory power is lost or impaired. It is a common symptom in affections of the larynx, both acute and chronic, and is sometimes one of the first diagnostic signs of serious disease.

Injuries of the Larynx.

Concussion of the larynx is described by several of the older writers as a reflex spasm of the glottis caused by a sudden external blow. It is probable that in the cases reported the threatened asphyxia has been due to intralaryngeal extravasation.

Contusion of the larynx occasionally has been observed. Its results may be slight and limited to the rupture of a few submucous vessels, or the extravasation may be extensive and even dangerous. Complicating fracture or dislocation of the cartilages may cause rupture of blood-vessels, nerves, and ligaments.

Etiology.—Blows, strangling, attempts at hanging.

Symptoms.—Its chief symptoms are aphonia and dyspnœa, the latter sometimes urgent. Laryngoscopic examination will usually reveal the nature and location of the lesion.

Treatment.—Submucous extravasations of moderate extent are best treated, when seen early, by local rest, cold, and the application of astringents.

Wounds of the Larynx and Trachea.

Wounds of the larynx and trachea generally occur as complications of more extensive injuries of the neck, involving division of the great vessels and speedy death. Sometimes, however, incisions of considerable size may be made in the larynx or trachea, the cervical vessels receding before the edge of the knife and thus escaping injury.

Etiology.—Wounds from within outward may be caused by the swallowing of a foreign body or by attempts at endolaryngeal operations. They may be attended with inflammatory swelling and with hemorrhage. From without inward they may be surgical or accidental. The latter are common in civil practice from suicidal and homicidal attempts, some sharp cutting weapon being employed. Rarely they are the result of penetration, as by a dirk or gunshot.

Symptoms.—Large wounds, especially through the trachea, may be accompanied by extensive separation of the parts, increased by extension

of the head and also by inspiration. Hemorrhage is generally severe, even when the large vessels have not been injured. The entrance of blood into the air-passages is an additional source of danger. Breathing is sibilant, and frothy blood and mucus are thrown out. There is more or less aphonia, caused by injury to the vocal bands, division of the recurrent nerves, the inferior location of the wound, and later by œdema. Dysphagia and thirst are marked. Small oblique wounds sometimes cause emphysema and rapid asphyxia. Dyspnœa may also arise from the passage of blood into the bronchi and from the obstruction due to partly detached fragments of tissue. Death may quickly follow these wounds from hemorrhage and from the asphyxia caused by it. More often their gravity consists in the inflammation or the septic infection which is apt to complicate the smaller wounds, and in the necroses the inhalation of detached fragments, the growth of granulations, secondary hemorrhage, tracheo-bronchitis, pleurisy, and broncho-pneumonia. Death follows in from eleven to fourteen days, and in uncomplicated cases recovery in from thirty to forty. As sequelæ defective voice, stenosis of the larynx, and tracheal fistula sometimes occur.

The **prognosis** is serious, 24 per cent. of large, 52 per cent. of small, and over 40 per cent. of gunshot wounds proving fatal.

Diagnosis is difficult only in the case of small punctured wounds, in which the escape of air or the presence of emphysema will indicate the real nature of the injury.

Treatment.—Often prompt and energetic treatment is necessary to save life. Union by first intention can hardly take place. Provision, therefore, should be made for drainage even where the wound is clean and uncomplicated. Usually hemorrhage must be checked and asphyxia prevented. The air-passages must be cleared of blood, partly detached fragments of tissue removed, a tracheal cannula inserted, the strength of the patient sustained, and all of the lesser indications which arise in special cases actively met. It may be necessary to perform tracheotomy, both on account of the asphyxia and to relieve the hemorrhage, which the asphyxia increases. If necessary, the tampon-cannula should be employed. Some recommend a preventive tracheotomy, especially in cases in which the constant attendance of a surgeon cannot be secured, in view of the danger of displacement of the wounded parts of the trachea or larynx or of sudden œdema of the larynx. This, however, is not always necessary. Sometimes the introduction of a large catheter or other suitable cannula may give the required relief. Where the wound is near the crico-thyroid space intubation will sometimes be valuable.

Fracture of the Larynx.

While advanced age predisposes to this accident through calcification of the cartilages, it has been known to occur in young persons, and even in infants. It is most common in men. It is generally due to direct violence, either from immediately in front or from pressure applied to both sides, as from blows, pressure of the cord in hanging, or from attempted strangling. It may be simple or compound, incomplete or complete. The thyroid is most often implicated, the cricoid next, while fracture of both is unusual, and that of the arytenoids very rare. Bilat-

eral pressure is apt to cause longitudinal fracture of the thyroid or cricoid at or near the median line. By direct violence from in front the larynx is driven against the vertebral column, and the thyroid may thus be fractured in various directions, the fragments sometimes being driven inward. The cricoid is usually fractured bilaterally, sometimes with a third fissure posteriorly and near the median line. Together with the above there may be injuries to the greater cornua of the hyoid bone and to the arytenoids, laceration of the mucous membrane, hemorrhagic infiltration of the vocal cords, and tearing of the laryngeal muscles. Fracture may be complicated with fractures and wounds of neighboring parts and with injury to the external jugular vein.

Symptoms.—The symptoms are of varying severity. Functional disturbance from injury to the recurrent or pneumogastric nerves may be severe. The expectoration of frothy blood or of bloody mucus at or shortly after the time of the accident is always present. Stridulous respiration; dyspnœa, generally immediate but sometimes delayed; more or less aphonia; dysphagia; and sharp pain in the larynx, increased on pressure. Inspection of the region of the larynx will reveal swelling and ecchymosis, and over the larynx itself various irregularities caused by the separation of fractured fragments, with unusual flexibility, mobility, or even crepitation of the cartilages. All of the latter signs may be absent, especially if the case is examined some time after the accident, as extensive emphysema may have supervened.

The symptoms are sometimes so slight as to be hardly recognizable, and the patient makes a speedy recovery. Generally, they are either severe from the first, or gradually become so from the development of endolaryngeal extravasation, œdema, or the displacement of fractured parts, any of which may cause death by asphyxia. Later, the danger is from abscess, necrosis of fragments, and the formation of deforming cicatrices, and consequent stenosis of the larynx.

Prognosis.—The prognosis in serious cases is bad, and even in the less severe ones dangerous complications may suddenly develop. The rate of mortality is very high, especially in fractures of the cricoid. Resulting cicatricial stenosis of the larynx may make the permanent wearing of a tracheal cannula necessary.

Diagnosis.—Diagnosis is easy except where there is little displacement and much swelling, although the number and location of the fractures are not always easy to recognize.

Treatment.—Several methods of treatment have been recommended: while some cases have recovered without surgical aid, tracheotomy has generally been advised when dyspnœa threatens. In fractures with displacement tracheotomy may be followed by attempts at replacement of the fragments and their retention in position by means of a suitable support. Some surgeons advise a thyrotomy and the separation of the two halves of the larynx until the fragments have united in good position, or, if some have become detached so as to obstruct the larynx, to either replace or remove them. Wagner, having done tracheotomy and inserted a tampon-cannula, divides the larynx in the median line, separates the thyroid, asepticizes the wound, replaces or removes the fragments of cartilage, and packs the cavity of the larynx with iodoform gauze. Unquestionably, in the treatment of the future the use of the

O'Dwyer intubation apparatus is likely to play an important part. In the lighter cases it should take the place of tracheotomy, and in the more severe ones, even where tracheotomy may be required, no better support for the interior of the larynx could be found. In conditions threatening sepsis it would hardly be indicated, Wagner's method probably offering in these the best prospects of success. At best the history of these cases is far from encouraging.

Fracture of the Trachea.

Fracture of the trachea, when it occurs, is often associated with that of the larynx. It is due to some injury causing violent compression of the neck, and is usually transverse, with everted edges. In longitudinal fracture, usually located in the cervical region, the edges are inverted and cause obstruction. It is sometimes found at the bifurcation of the trachea in injuries of the chest.

The **symptoms** are—dyspnœa, extravasation, and emphysema. There is pain on pressure over the seat of the fracture. The latter, however, is apt to be concealed by the swelling.

The **prognosis** is bad. The patient should be placed in a condition of complete quietude, and, if dyspnœa occur, tracheotomy be performed.

A case has been reported in which one of the upper rings of the trachea was invaginated by force into the one above it. In another case the death of an infant was caused by a too wide separation of the incision in a tracheotomy, resulting in a pushing forward of the posterior wall of the trachea and consequent asphyxia, although the cannula was in position.

Burns of the Air-passages.

Causation.—Burns of the air-passages may be caused by the inhalation of flame or steam, or by the swallowing of hot or of caustic liquids.

Burns of the larynx are generally accompanied by other burns—of the mouth, tongue, pharynx, and nasal passages. The œsophagus may be attacked, although the liquid is in most cases regurgitated before it has been completely swallowed. Such accidents are quickly followed by acute inflammation, and sometimes by considerable swelling. The inflammation may extend to the trachea, bronchi, and lungs.

Symptoms.—The early symptoms are pain, dyspnœa, dysphagia, aphonia, and shock. Respiration is rapid and stridulous, the countenance pale and anxious, and there is marked restlessness. The symptoms may be mild at first, but later severe, especially after the ingestion of caustic liquids. Generally, after a little while, œdema of the larynx and fatal dyspnœa supervene, or, if these are escaped, pulmonary complications quickly follow.

The **diagnosis** may be made from the history of the case and, when this is unobtainable, from the lesions visible in the buccal cavity.

Prognosis.—Mild cases may recover in a few days. More often the prognosis is serious, and death results in from one to two days from shock or dyspnœa, or, later, from laryngitis, bronchitis, and pneumonia. Cicatricial stenosis of the larynx often results.

Treatment.—The inhalation of flame or of steam is always a grave

Solids.—Directly and remotely, the entrance of a foreign body into the air-passages must always be regarded as one of the most serious of accidents. It may occur at any age, although it is decidedly more common in children than in adult life.

The introduction of a foreign body through an external wound is unusual. Occasionally such bodies may penetrate from other regions into the air-passages. For instance, they may ulcerate through the walls of the œsophagus and thus enter the trachea. A necrosed laryngeal cartilage may be inhaled, or even a sequestrum from the sternum may enter.

The variety of bodies which may be inhaled is unlimited. Their size is necessarily restricted to the diameter of the glottic aperture. Of course upon the size, shape, nature, and seat of lodgement of the object will depend largely the degree of harm which it may be capable of doing.

Foreign bodies which have actually entered the air-passages may be arrested in various situations. They may simply lodge in the larynx itself, or may be detained in one of the ventricles or wedged in the rima glottidis. They may descend below the larynx and become fastened in the trachea, or descend to the bifurcation of the trachea, or through one of the greater bronchi into one of the more remote bronchial tubes. Owing to the peculiar conformation of the bifurcation, the right bronchus is more apt to be the seat of lodgement than the left.

The **symptoms** vary somewhat with the size, shape, and position of the foreign body. The symptoms, usually sufficiently well marked, are sometimes extremely obscure. The primary symptoms are—violent spasm of the larynx, choking, cough, and distress; sometimes vomiting occurs, with relaxation of the sphincters. Blood may be coughed out immediately after the accident. The dyspnœa may prove speedily fatal, especially when a large body suddenly occludes the larynx. The body is sometimes thrown out by the cough. Often these symptoms subside after a time, but certain signs remain, suggesting its presence. The accident may be unrecognized, because the initial dyspnœa and cough may, in some cases, be lacking. The voice is, of course, likely to be affected. Later symptoms are—modification of the voice, continued discomfort, quickened respiration, cough accompanied with expectoration of frothy or bloody sputum. If the foreign body is fixed, the symptoms may tend to subside; but if it be movable, a change in its position is very apt to be accompanied with fresh attacks of the urgent symptoms. The general condition of the patient may not suffer, but, on the other hand, very rapid loss of strength, appetite, and weight may ensue.

In the case of a foreign body in the trachea the main symptom may be a severe reflex cough, together with certain changes in the current of inspired air heard upon auscultation. A foreign body in one of the bronchi, unless relieved, will almost certainly cause death. Following the exclusion of the air, pneumonia may readily develop, or, if the foreign body be particularly irritating in its character, abscess or gangrene of the lung may be established. In such a case the diagnosis will often be a matter of extreme difficulty unless a clear history of the inhalation of the body be obtainable. Auscultation will sometimes reveal at a certain point in the neighborhood of one of the larger bronchial tubes such changes in the air-currents as will indicate partial occlusion.

Prognosis.—The prognosis is exceedingly grave, both from the immediate result and from the possible secondary complications. It is more serious in the child than in the adult. It is exceedingly serious in case of the inhalation of caustic substances or of foreign bodies, such as beans, which are capable of swelling. The long-continued presence of a foreign body in the air-passages may simulate phthisis.

The pulmonary complications are, of course, very grave. Yet several cases are on record in which a head of grain, such as barley, inhaled into the lungs, has produced abscess of the lung, breaking externally, with extrusion of the foreign body, and, in one case, recovery.

Diagnosis.—The diagnosis, when difficult, depends upon the suddenness of attack, the absence of fever, and the fact that the patient is comparatively well between the attacks of dyspnœa or spasm. Sometimes the patient is conscious of the movements of the body in the trachea. The presence of a foreign body in the œsophagus, causing urgent dyspnœa, may generally be demonstrated by means of the œsophageal sound. When the foreign body has entered a bronchus the passage of air into the lung of that side is, to a greater or less extent, prevented. There will, therefore, be a lack of inflation and of respiratory murmur in that lung, without corresponding dulness or other symptom of acute pulmonary disease.

Great aid may be obtained by the use of the laryngoscope, the parts in and above the larynx having been thoroughly anæsthetized with cocaine; even in cases where the body has fallen as low as the bifurcation of the trachea its presence may thus be demonstrated.

The **treatment** of foreign bodies in the air-passages is one of the most difficult matters in all surgery. The question of operation has always been a vexed one, the statistics, although not satisfactory, being slightly in favor of surgical interference. In simple cases it is not good practice to excite cough, sneezing, or vomiting. Even the inverted position, assisted by percussion upon the back, is not recommended, although often effective with children choked from the ingestion of too large morsels of food, the danger being the causing of spasm of the glottis by the impact of the body upon the vocal bands. If the foreign body is impacted in the larynx, it may be removed through the natural passages, in the case of large objects, by means of the finger or a pharyngeal forceps. Smaller bodies should be removed, with the aid of the laryngoscope, by means of suitable endolaryngeal instruments, the parts having first been thoroughly cocainized. Much ingenuity on the part of the operator may be called for in these cases. If the object is too large to be removed at once, it may be crushed and taken away piecemeal. If the foreign body has fallen into the trachea, one of the tubes specially constructed for such causes by O'Dwyer may be inserted, in the hope that the object may be expelled through it. If it has become impacted in the larynx in such a way that it cannot be extracted otherwise, thyrotomy may be indicated, or if the object is small a cricothyrotomy. When the body has entered the trachea, tracheotomy is required. The trachea should be opened low down, and, unless the body is easily reached and expelled, several rings should be divided and the edges of the wound widely separated, the patient inverted, and efforts made, by palpating the chest or by exciting cough, to cause its expulsion.

If necessary, long slender forceps may be used for dislodging it. Sometimes, the trachea having been opened, the foreign body will continue to remain in position, refusing to be expelled until after the lapse of several days.

Perichondritis of the Larynx.

Perichondritis of the larynx is an inflammation of the perichondrium and of the cartilages, sometimes followed by caries or necrosis of the latter. It is most common in men and at about the age of thirty. It is generally secondary, and rarely primary. Among its most common causes are tubercular, specific, and cancerous ulceration of the larynx. It may also follow typhoid fever, variola, scarlet fever, erysipelas, and pyæmia. It is sometimes occasioned by injuries to the larynx in the use of the œsophageal bougie or by other traumatisms, such, for instance, as cut-throat or from the impaction of a foreign body. Primary perichondritis may result from simple catarrh, over-use of the voice, or from causes which are obscure. It is said also to have been caused by prolonged decubitus from pressure of the cricoid upon the vertebra. The cricoid and the arytenoid cartilages are most often attacked. When the perichondritis is due to deep ulceration, necrosis of the cartilage is apt to follow through impairment of its nutrition. Separation of the fragment thus affected sooner or later takes place. In some cases the destructive process is rapid and the sequestrum is quickly detached or thrown off. While perichondritis is usually a suppurative process, it is probable that in some cases the acute symptoms are either not present or else escape observation. Aside from the destruction and exfoliation of the cartilage, and the deformities, often leading to stenosis of the larynx and sometimes to fistulous openings of it, which it may cause, the most important effects of this disease are the various ankyloses it may occasion, the most important of them being ankylosis of the crico-arytenoid articulations. This condition may be serious when it affects to any marked degree the abduction of the vocal bands, and hence the opening of the glottis.

The **symptoms** are often obscure, and are not very characteristic. Generally, the thyroid or cricoid cartilages are affected, and the pain will be increased by external manipulation of the larynx. In the case of the epiglottis and of the arytenoids dysphagia will probably be present, and in the case of the latter there may be pain on phonation. Laryngoscopic examination, aided by the use of the laryngeal probe, may demonstrate the existence of exposed cartilage; fragments of the latter may be expectorated or may hang more or less loosely in the laryngeal cavity, thus possibly causing dysphagia and aphonia, and the symptoms externally may be such as to point directly to the nature of the difficulty. The results of direct examination may differ somewhat in accordance with the seat of the affection.

In perichondritis of the arytenoid, generally tuberculous, there is tumefaction, limited to the lateral and posterior region of the upper aspect of the larynx, with immobility of the corresponding vocal band. Inflammation of the cricoid, generally located in the posterior part of it, occurs usually at the same time as that of the arytenoid. When the thyroid is attacked symptoms of stenosis of the larynx are evident. At

the affected point an abscess may develop, which may result in a fistulous opening.

Diagnosis must be based on the exclusion of other acute affections, together with the result of the laryngoscopic examination. External palpation and inspection will often give useful testimony, while the nature of the concurrent disease, and the fact that it may be attended with this complication, will afford aid.

The **prognosis** must depend, to some extent, upon the cause of the disease. Suppurative perichondritis, with necrosis, is often a very serious condition, not only because of the accidents which may occur in its course directly and immediately, threatening the life of the patient, but also on account of the laryngeal stenosis which will ultimately result from it.

In tubercular and malignant disease of the larynx the prognosis is bad. In the syphilitic form, however, excellent results are obtained through the prompt and energetic use of the iodide of potassium, given in large and frequently repeated doses. The iodide may be best administered in these cases in milk thickened with pepsin, an excellent formula being—

℞. Potass. iodid.,	gr. x;
Essence of pepsin,	ʒj;
Milk,	ʒiv.

The above, made into a junket, is palatable, nutritious, and easily swallowed and digested.

In all cases where the symptoms are acute, active antiphlogistic measures are called for, such as the application of cold compresses, the sucking of cracked ice, scarification of the endolaryngeal tissues, and the prompt opening of abscesses. In evacuating the latter the incision should be made quickly, and the patient placed in such a position as to enable him to rapidly expel the discharged pus.

In exceptional cases perichondritis of the posterior aspect of the cricoid causes such marked dysphagia that it is necessary to feed the patient through an œsophageal tube. It is desirable to avoid this if possible, on account of the injury which may occur to the already diseased part.

Where dyspnœa threatens the life of the patient, tracheotomy has heretofore been recommended, and is, of course, indicated where other means are not obtainable. The use of the O'Dwyer tube, however, has proved to be of great value with such patients, not only in overcoming the dyspnœa, but in maintaining, as far as possible, the original contour of the interior of the larynx, and thus preventing, in some degree, the stenosis which would otherwise follow. Such cases should be watched over for a long period of time, and any tendency to deformity of the larynx, if possible, counteracted.

Permanent ankylosis of one crico-arytenoid articulation will probably result in little harm to the patient; where the fixation is bilateral, however, the glottic aperture may be narrowed to a dangerous degree, and thus some operative measure be necessitated. As between tracheotomy, Schrötter's dilators, and O'Dwyer's tube, the latter is incomparably the best.

Stricture of the Larynx.

Stricture of the larynx is a narrowing of the cavity of the organ, occasionally due to pressure from without, but almost invariably caused by some change in its inner contour, either congenital or brought about by disease, and resulting in more or less impairment of its normal functions. Stenosis due to inflammatory thickening and to new growths is considered elsewhere.

This section will deal with cases of permanent deformity, the result of previous disease or injury, and caused either by displacement of the parts or, as is most commonly the case, by the presence of deforming cicatrices. Fractures, perichondritis, chondritis, ankylosis of the arytenoid articulations, and that singular condition known as "web of the larynx" may occasion it, but it is generally due to injury or ulceration of the soft tissues which line the larynx. By far the most common cause is tertiary syphilis. The variety of deformities it may cause is very great, ranging from a slight narrowing of the glottic aperture up to complete occlusion of it. It may be due also to other diseases causing deforming cicatrices, and to destruction of the soft parts due to burns.

The so-called *corditis inferior hypertrophica* consists in a narrowing of the space immediately below the vocal bands by a ring of thickened tissue. Stenosis of the trachea may occur at various parts of this canal. Its calibre may be greatly reduced by bands of fibrous tissue which distort the tracheal rings, and sometimes cause their partial absorption to such an extent that the normal character of the part is lost. Sometimes these changes occur throughout a considerable extent of the trachea, and are associated with similar lesions of the larynx or extend even into the pharynx. Between the points of stricture are occasionally seen dilatations of the tube.

The **symptoms** of stenosis of the larynx may be divided into three stages—that of active disease, that of stenosis, and, finally, that of suffocation. On the other hand, the symptoms at first may be mild and progressive, the first sign noticed being a slight degree of laryngeal stridor. This increases, being especially marked on inspiration, and is later accompanied by dyspnœa, and often by change in the quality of the voice, which becomes hoarse in stenosis of the larynx or simply weak in stenosis of the trachea. Later in the disease dyspnœa increases and attacks of suffocation may occur. Respiration is feeble and slow. The attacks of urgent dyspnœa are apt to take place at night, and are due to spasm of the glottis. Death may be caused by sudden asphyxia or by such pulmonary complications as congestion, pneumonia, and œdema. Sudden death from syncope will occur in a certain number of these cases: it is supposed to be due to an inhibitory action upon the bulbar centres. In stenosis of the trachea the point of greatest constriction may sometimes be determined by auscultation. A laryngoscopic examination is of great importance in these cases, sometimes demonstrating the tracheal lesion, and always giving most valuable information as to the condition of the interior of the larynx.

Diagnosis.—In diagnosing this condition it is necessary to establish, first, the existence of a stricture; second, its position and character. Since stridor is the chief diagnostic symptom of stenosis of the air-

passages, it is necessary to observe the character of the tracheal murmur, always diminishing in intensity; the tracheal râle, moist and modified by coughing; and the asthmatic character of the sounds heard sometimes in expiration. In determining the seat of the stricture it has been said that if hoarseness has preceded the dyspnœa, the stenosis is in the larynx; if dyspnœa preceded, it is tracheal.

The presence of a mediastinal tumor, possibly compressing the trachea or bronchi, may be revealed by examination of the chest; tumor of the neck may be recognized by palpation of this region, and a laryngoscopic examination will establish the differential diagnosis between paralyses, tumors of the larynx, and actual stenosis.

Prognosis.—The prognosis is serious, especially in stenosis of the lower part of the trachea, which is almost necessarily fatal.

Treatment.—The treatment in these cases consists especially in dilatation of the stenosed parts.

For the relief of *stenosis of the larynx* many methods have been proposed. All else failing, in chronic cases the permanent use of a tracheal cannula is always possible. For the actual relief of the stenosis the application of intubation has accomplished a revolution both in the ease with which it can be treated and in the prognosis. The results of dilatation by means of the O'Dwyer tube may be greatly assisted by the careful and judicious division of constricting bands of cicatricial tissue before the tube is introduced. In the case of a congenital web of the larynx the simple wearing of the tube has been known to cause the disappearance of the obstruction. In these cases removal of the web by means of a suitably-formed cutting instrument or its simple incision before the introduction of the tube has given brilliant results. The larynx is remarkably tolerant of the tube, breathing is carried on normally while it is in position, and deglutition is not materially interfered with. The patient should be examined at short intervals, the tube occasionally removed, and, if necessary, a larger one inserted in its place. This treatment should be continued until the necessary enlargement of the interior of the larynx is secured.

Fistula of the Larynx and Trachea.

Etiology.—Fistula of the larynx, more common than that of the trachea, may be caused by abscess, syphilis, tuberculosis, or typhoid fever. It may also be due to a foreign body, a new growth, or an external wound. Incision of the trachea made in the course of tracheotomy usually closes unless there is stenosis of the parts above.

Symptoms.—The distinguishing sign of this condition is the passage of air through the external opening, together with mucus, and sometimes of pus and broken-down tissues. Respiration is generally normal unless there is stenosis of the larynx, but the voice is often modified by the escape of the expired air, and in some cases phonation is impossible unless attempted when the opening is artificially closed.

The external orifice of the fistula may be readily detected. Its internal opening may sometimes be demonstrated by the aid of the laryngoscope.

The **prognosis** is not serious, although these cases are sometimes difficult to cure.

Treatment.—The treatment consists of the closing of the fistula,

any existing condition of stenosis of the larynx or trachea first having been removed. Fistulæ of small diameter may be closed by the application of mild caustics or of the galvano-cautery. When of larger dimensions other means must be employed. Vivifying of the edges of the fistula and uniting them with sutures, while sometimes possible, is apt to be unsuccessful, owing to the mobility of the parts and to the tendency of the air from within to cause separation or dilatation of the wound.

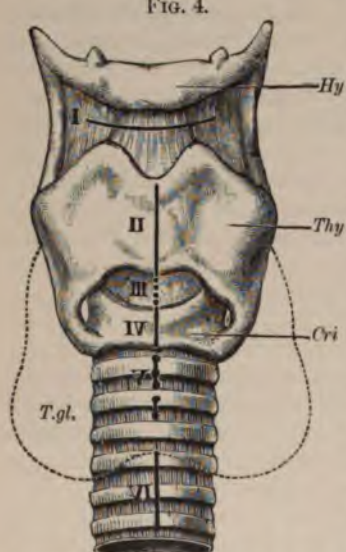
As a rule, some plastic operation, such as Berger's or Abbe's, will be required to thoroughly close the opening.

Tracheotomy.

Tracheotomy is a general name for several operations employed for the admission of air to the trachea where the latter, or the approaches to it, have become obstructed. These operations are four in number—namely, crico-thyroid laryngotomy, made through the crico-thyroid membrane; laryngo-tracheotomy, through the cricoid cartilage and the first ring of the trachea; suprathyroid tracheotomy, made above the isthmus of the thyroid gland through two or three of the upper rings of the trachea; and infrathyroid tracheotomy, made below the thyroid isthmus.

The relations of the trachea in connection with these operations are important. As to the thyroid isthmus, which determines the position of two of them, this body in the adult crosses the second and third rings of the trachea, sometimes even the fourth, while in the child it is narrow, and usually somewhat higher up, sometimes even lying on the crico-tracheal membrane. In dissecting down to the trachea in the median line of the neck, from the cricoid cartilage to the sternum, the following parts are met with: subcutaneously, the anterior jugular veins appear, usually lying somewhat apart on each side of the median line, generally not communicating with each other except by a large transverse branch, which lies in the interfascial space just above the manubrium of the sternum. Sometimes these communicating branches directly over the trachea are numerous, occasionally forming almost a complex network, while in other cases there will be a single vein following the median line. Under the above layer comes the cervical fascia, enclosing the sterno-hyoid and the sterno-thyroid muscles. Above the isthmus there is sometimes a transverse communicating branch between the superior thyroid veins. Anomalous branches of the superior thyroid artery may cross the upper rings of the trachea. Over the isthmus there is a small venous

Fig. 4.



Operation on the larynx and trachea (Tillmann's): I, subhyoid pharyngotomy; II, thyrotomy; III, laryngotomy; IV, cricotomy; V and VI, high and low tracheotomy; *Hy*, hyoid bone; *Thy*, thyroid cart.; *Cri*, cricoid cart.; *T.gl.*, thyroid gland.

plexus from which the inferior thyroid veins arise. Below the isthmus these veins lie in front of the trachea, together with a small artery which sometimes exists there. The inferior thyroid vein may appear as a single trunk running in the median line. Before the second year the thymus gland extends up for a variable distance in front of the trachea. At the lowest part of the neck the latter is crossed by the innominate and the left carotid artery and by the left innominate vein.

Tracheotomy is easier performed high in the neck than lower, for the anterior jugular veins are smaller above, and transverse branches are rare; the muscles are somewhat separated above, while below they are in contact; the great vessels are far away, and the inferior thyroid veins are avoided. Here, too, the trachea is more readily reached and more readily held in position. The lower the incision in the trachea, the more easily will pus be conducted into the mediastinum, and the more likely is the occurrence of bronchopneumonia. On the other hand, particularly in the adult, the necessities of the case will sometimes demand a low operation.

FIG. 5.

Trousseau's tracheal dilator.

The instruments required for tracheotomy are—two scalpels; dissecting, artery, and pressure forceps (of the latter French's are the best); a tenaculum; a blunt hook; scissors, blunt- as well as sharp-pointed; a pair of small retractors; a short, slightly curved director; a tracheal dilator; needles; tracheotomy-tube; and tapes. A gag and tongue forceps may be found valuable, while a new silver catheter, long enough to be passed into the larynx, may give material aid in case of sudden dyspnœa from occlusion of the larynx before the trachea is opened.

The Tube.—The tube should be selected with careful reference to the case in hand. The one now in common use goes under the name of Trousseau. In this the curved outer cannula is loosely attached to a movable neck-plate, the latter being perforated to receive the tapes by which the instrument is held in place. An oval opening is sometimes made in the upper side of the cannula, although this is not always necessary and may be objectionable. The thickness of the tissues covering the trachea varies so greatly in different individuals that tracheal tubes made upon the same plan are not adapted to all persons. Durham has devised a cannula the length of which can be regulated by means of a screw-collar in the neck-plate. The cannula itself is straight until within a short distance of its distal end, where the curve is so sharp that the inner tube must be made with a spiral end, which renders it capable of being inserted at any angle. For certain patients Durham's tube is a great improvement upon the ordinary form. The jointed inner cannula, however, is more difficult to keep clean than the ordinary one, and in time the joined segments may

FIG. 6.

Silver tracheotomy-tube.

become detached from erosion and drop into the trachea. The removal and reinsertion of the outer tube after the wound in the neck has closed around it is more difficult with this than with the old-fashioned tube, on account of the difference in the curve. This defect has been avoided in the tube devised by Keen.

König's tube, designed for the relief of stenosis occurring low down in the trachea, is about four and a half inches long, and the greater part of the cannula is made of wire wound into a close spiral, which enables the instrument to be passed through the tracheal wound and beyond the obstruction. It is sometimes desirable to enable the expiratory current to be forced through the natural passages above. To accomplish this Luer has devised an instrument furnished with a ball-valve. During inspiration the ball is raised from the orifice and the air admitted, but during expiration it falls against the outer opening, closing it and forcing the air into the larynx.

FIG. 7.

Keen's tracheal cannula.

Many different devices have been made for the performance of rapid tracheotomy. In view of the uncertainties and the dangers of accident arising from their use they have never become popular, and in this country, at least, are practically never used.

Tracheal tubes are composed of silver, aluminum, and hard rubber. As a general rule, metal tubes are preferred. But while the hard-rubber cannula is more easily broken, and its calibre is not so large in proportion to the outer diameter as that of the metal ones, it is, nevertheless, very useful when the tube is to be worn but for a short time, and is by some persons preferred because of the more comfortable sensation imparted to the throat than by the metal. A surgeon called upon to do tracheotomy with any degree of frequency will find it a great advantage to have an assortment of vulcanite tubes on hand. The emergencies which call for their use are apt to be sudden, and in case it should be necessary to introduce a tube, one made of hard rubber will answer the purpose at least until a perfectly-adapted metallic tube can be obtained.

The indication for tracheotomy is the presence of an occlusion of the normal opening of the larynx, from acute or chronic causes, which interferes with respiration, provided that this stenosis is sufficient to endanger life and that it cannot be overcome by other means. The operation in itself is usually not dangerous, nor is it likely to cause serious complications to the disease for which it is employed. Its early performance where indicated, therefore, should, wherever possible, be advised.

When practicable, anæsthesia should be employed before this operation. Three means may be considered—ether, chloroform, and cocaine. Of these, ether is the least desirable, requiring longer time and producing greater irritation. It also causes nausea and vomiting, and is apt to stimulate those movements of the larynx which are such a source of discomfort to the operator during the operation. Chloroform is non-irritating, rapid, and less objectionable to the patient. It does

not excite reflex movements of the larynx. While generally less safe than ether, the conditions under which tracheotomy is likely to be performed are apt to be such as would make its use preferable to the latter in this operation. The hypodermic injection of cocaine immediately over the site of the wound has been recommended as producing a satisfactory condition of local anæsthetization. In the experience of the writer this plan has not always succeeded in allaying the pain. In tracheotomizing children, especially in diphtheria, chloroform is apt to be contraindicated. Its administration may cause rapid increase of dyspnœa, and greatly complicate an operation which under the conditions of cyanosis present is not likely to create suffering.

In selecting the operation to be performed, it may be said, in general, that operations below the larynx, as a rule, are preferable to crico-thyrotomy or laryngo-tracheotomy. While the latter are easier because the parts incised lie nearer to the surface, the insertion of the tube in such near proximity to the larynx may be followed by injury to that organ or to some of its functions. Division of the cricoid cartilage and dilatation of it sufficient to admit the tube may cause it to be fractured, particularly in adults in whom it has become more or less calcified. In such patients, particularly if the tube is to be worn habitually or if the operation be done preliminary to an extirpation of the larynx, the lower operation, which is far less difficult in the adult than in the child, is to be preferred. In the latter, on the other hand, the increased difficulty of the low operation, and the transient necessity, as a rule, for the wearing of the tube, render the higher operation the more desirable.

The operation of tracheotomy is generally performed as follows, under chloroform unless contraindicated by dyspnœa and laryngeal irritation, and with proper antiseptic precautions: The patient is placed upon his back near the right side of the operating-table. A sand-bag or other suitable firm support is placed under the neck and shoulders, and the head allowed to bend backward in extreme extension. In this position

FIG. 8.

Position of patient for tracheotomy.

the anterior structures of the neck are rendered tense, the trachea steadied, drawn as far upward as possible, and brought somewhat nearer to the surface of the neck. The superficial veins are also somewhat emptied by this position. To the assistant who administers the anæs-

thetic is also given the duty of holding the patient's head steady and of keeping the chin exactly in the median line. This latter is a consideration of great importance to the surgeon, the accuracy of whose incisions is likely to be determined by the careful observance of it. At least one other assistant is desirable to attend to the bleeding and superintend the instruments and the tube.

Before making the first incision the operator should clearly define the position of the thyroid and cricoid cartilages and of the median line. With a sharp scalpel, the blade of which should be held between the thumb and finger, an incision should be made through the integument from an inch to an inch and a half long, and precisely in the median line, downward from the level of the upper border of the cricoid, the parts on each side of the cut being steadied meanwhile by the thumb and fingers of the left hand. The movements of the thorax in respiration make it impossible to support the right hand upon the chest during the performance of the operation. Next, in the same way as above, the subcutaneous fat and the anterior cervical fascia are divided, the incision being kept absolutely in the median line. By successive incisions, aided by the director, the sterno-hyoid and sterno-thyroid muscles are reached, and the space between them opened, and the fascia covering the trachea demonstrated. Then, keeping strictly in the median line, the deep fascia is divided and the trachea laid bare. For the division of the fascia the help of a director is valuable. Any veins encountered at this point in the operation should be pushed aside with the handle of the scalpel. The isthmus of the thyroid must be similarly pushed downward, and, if necessary, held out of the way with a small blunt retractor. The tracheal rings may now be felt with the finger, the fact that the trachea is actually laid bare assured, the exact situation of the cricoid noted, the precise position of the intended opening into the trachea located, and, above all, the situation of the median line carefully kept in view.

For the next division of the operation the following should be in absolute readiness and at hand—namely: A sharp scalpel or tenotomy knife, the tenaculum, the tracheal dilator, a damp towel, and, finally, the tube, to which a tape of suitable length to twice surround the neck of the patient should have been passed into one of the eyelets at the side of the neck-guard. Everything being in order and if possible all bleeding controlled, a small sharp tenaculum is passed into the cricoid cartilage in the middle line, and held by the assistant, who stands behind the patient's head. His duty is to keep the tenaculum in the median line, and with it to draw the cricoid forward and keep the trachea steady and tense. The up-and-down movement of the larynx in respiration will make it necessary to not hold the hook too rigidly. Having selected which rings to divide, the operator introduces the scalpel into the wound, the edge of the knife being directed upward, and, guided by the left fore finger, inserts the knife, exactly in the median line, into the lowest of the two or three selected rings (usually the first three of the trachea) and cuts directly upward toward the tenaculum. The latter is still held in position, and the knife not removed from the tracheal incision, but turned slightly upon its vertical axis, so as to separate the sides of the opening and admit the tracheal dilator; with the latter instrument the opening is sufficiently dilated to enable the tracheal tube to be passed. This should

be done as easily and expeditiously as possible, and the tube at once secured in position by passing one end of the tape around the patient's neck, through the unoccupied eyelet of the neck-plate of the tube, and back around the neck, to be tied to its fellow.

From the moment that the tenaculum is fixed to the cricoid the situation is critical. The presence of the hook excites such urgent reflexes of the larynx that from the moment it is introduced until the trachea is actually opened the patient in many instances cannot breathe. When air is first admitted through the trachea, the effect of its sudden entrance is to excite such expulsive efforts of cough that the mucus, blood, or membrane which may be in the trachea are projected forth with great violence, often in the direction of the operator. To meet this difficulty, an assistant should stand ready with a damp towel, which as the tracheal incision is separated and the dilator introduced, should be held a short distance above the wound, and the matters expelled thereby prevented from interfering with the operator.

In no case should the tube be introduced without previous separation of the edges of the tracheal incision. Disregard of this rule will defeat the attempt at introduction, and may result in serious injury to the parts. This is particularly true where the rings of the trachea, either through old age or the influence of a malignant growth, have become partly ossified. Pressure against the incision only forces its edges the more firmly together, while undue force may either fracture the cartilages or, from the slipping of the tube, force it downward through the tissues on the side of the trachea, thus inflicting damage. In such cases, where the tube must be worn habitually, it is better not to rely upon a simple vertical incision of the trachea, but to actually exsect a circular portion of the anterior wall equal in size to the diameter of the required cannula. The result is more comfortable to the patient, enables the cannula to be inserted more easily, and is better in many ways. When the tube is in place the tenaculum may be removed, and the wound below the tube brought together by one, two, or three sutures. A piece of lint properly shaped to cover and protect the wound is smeared with some antiseptic ointment and placed under the shield of the wound.

Suprathyroid Laryngotomy.

Suprathyroid laryngotomy or subhyoid pharyngotomy has, on rare occasions, been employed in the removal of a foreign body or of a new growth situated in the upper opening of the larynx, and particularly in the neighborhood of, or in connection with, the epiglottis. Although not very difficult, it has never become popular, and is seldom used, since the access to the larynx accorded by it is very small. In operating, a transverse incision is made through the thyro-hyoid membrane near the inferior border of the hyoid bone and parallel with it. By means of this incision the epiglottis is exposed, and, where possible, drawn through the wound. In patients in whom the neck is thick this is not easy. The growth is then removed, bleeding checked, and the wound closed. There are no important vessels in the way, and prompt healing should result. The statistics of the operation are not flattering to it.

Infrathyroid laryngotomy has been performed for the removal of

subglottic growths. In operating, the laryngotomy should be made several days before the attempted extirpation of the growths, in order to accustom the parts to the presence of the tube and thus reduce the irritation for the chief operation. In performing the latter the crico-thyroid space is well opened up and the cartilages separated as widely as possible. Space is then given for the removal of the growth, which should be effected by the aid of proper laryngeal instruments and methods, the cavity being sufficiently illuminated meanwhile to admit of thorough and accurate work. In readjusting the parts it is safer to allow a cannula to remain until the danger of obstructive inflammation of the larynx shall have subsided.

Laryngotomy.

Laryngotomy, performed by opening the larynx through the crico-thyroid membrane, is sometimes employed in place of tracheotomy. The operation is not as difficult as the latter, and may be performed more rapidly. It is not applicable to children, on account of the small size of the crico-thyroid space. While it may answer for emergencies, it is not desirable where the tube must be worn for any length of time. The only important vessels to be encountered are the crico-thyroid arteries, which cross this space and are usually of small size. They may, however, be large enough to give rise to serious hemorrhage.

The details of the operation are similar to those in ordinary tracheotomy, excepting that a preliminary incision is made a little higher up in the neck, beginning in the median line at the lower part of the thyroid cartilage, and extending downward from the crico-thyroid space to the cricoid. Having exposed the crico-thyroid membrane, a vertical incision should be made through it precisely in the median line. Here, as in tracheotomy, the surgeon must assure himself that he is actually in the air-passage before attempting to introduce the tube. The shape of the tube worn after this operation differs from the ordinary instrument, in that the curve of the cannula is oval. The incision in this operation, if preferred, may be made horizontally through the crico-thyroid membrane—that is, from right to left, instead of as described.

Bose's Method.—A so-called bloodless tracheotomy has been devised by Bose. For the performance of this a vertical incision, beginning opposite the centre of the thyroid cartilage and extending downward for about one and a half or two inches, is made in the median line. The tissues are divided to a point extending from the lower part of the thyroid to the upper part of the cricoid, and, the sides of the wound being retracted, a second incision transverse to the first is made along the superior border of the cricoid cartilage, dividing the lower part of the deep cervical fascia which lies in front of the trachea and which holds the thyroid isthmus. A blunt director is now introduced through this transverse incision, and by its means the fascia and the isthmus, together with all the veins connected with them, are fully separated from the trachea. A broad curved retractor is now introduced into the fascia, which, together with the other soft parts, is drawn downward, leaving the trachea bare. The subsequent steps of the operation are similar to those in ordinary tracheotomy, the cricoid cartilage being fixed by means of a double tenaculum and the rings incised. To be actually bloodless the

veins must be handled with great care. The operation recommends itself, also, by the greater ease of its performance.

The difficulty of tracheotomy may vary greatly in different cases. Thus in an emaciated adult nothing could be more simple. In fat, thick-necked infants, struggling for breath and with the surroundings which often accompany such cases, the procedure becomes one of the most trying and difficult in surgery. In spite of the urgency of the dyspnœa and the excitement of those about, time will be gained and the chances of success greatly increased by the painstaking performance of the steps of the operation. Rapid operation upon an adult is at times indicated, but in an infant it will lead to dangerous results. In the latter cases, where intubation will not temporarily relieve the emergency by reason of obstruction above the larynx proper, a catheter may be introduced into the larynx, and respiration maintained until the trachea has been methodically opened. In partial asphyxia after the operation artificial respiration often succeeds.

Contrasted with that of an adult, the child's trachea is not only much smaller, but far less resilient, moderate pressure upon it being sufficient to cause its collapse. Its cartilages are very soft, and in making the incision it is easy to cut beyond the desired point. Serious accidents have occurred from ignorance or disregard of this fact. The progress of the operation may be interfered with by the presence of the thyroid isthmus, but no evil result follows a necessary division of this body, care being taken, however, to confine the incision to the median line. In the adult this procedure is unnecessary. The question of postponing the tracheal incision until all bleeding has been checked must be settled by the exigencies of the case in hand, and, if emergency require, a tracheal tube should be introduced as quickly as possible, in spite of the presence of blood, venous congestion of the neck being, as a rule, quickly relieved by the free entrance of air into the lungs. The only accurate proof that the trachea has been entered is the rush of air which follows this performance, and, unless this has taken place, the surgeon should examine carefully to be assured that his incision has not simply divided the membrane in front of the tracheal wall instead of the rings of the trachea themselves.

Tracheotomy should be practised upon the cadaver in order that the details of introducing the tube may be acquired, so as to be carried out as neatly and skilfully as possible. In general, too great care cannot be exercised in seeing that the head is kept rigidly in the right position, and especially with reference to the median line; that all the main incisions be accurately in the median line; and that the exact location of the proposed incision into the trachea be clearly established. Haste, excitement, and meddlesome assistance must be avoided.

The after-management of the patient should be conducted with scrupulous care. For the first few days at least the patient should be under the supervision of an attendant thoroughly competent to provide the special assistance necessary in such cases. The tapes must be kept in order, and the tube frequently cleansed of secretion by withdrawing the inner cannula and cleaning it. The latter should be returned as quickly as possible. It should be thoroughly disinfected and well oiled upon its inner as well as upon its outer surface before being again introduced. In

the matter of feeding assistance will sometimes be gained by the use of the œsophageal tube, especially in children.

Thyrotomy.

The operation of thyrotomy consists in the complete division of the thyroid cartilage in the median line. It is employed in gaining access to the larynx for the removal of new growths or for other obstructive conditions, such as impacted foreign bodies, irremediable cicatricial bands, or the like. As it is likely to cause impairment of the voice, it should not be undertaken unless clearly indicated through failure of endolaryngeal methods to attain the desired end. On the other hand, in certain serious conditions it affords the best possible opportunity for the thorough accomplishment of the purposes for which it is performed, and in good hands has been attended with excellent results.

A preliminary laryngotomy or tracheotomy is required, the selection of the point at which the tube is to be inserted depending upon the situation of the growth and the probable length of time that the tube will have to be worn. In the case of extensive growths, especially when situated low down in the larynx, tracheotomy will generally be found preferable. Where the object to be removed is entirely above the vocal bands laryngotomy may answer the purpose. Should extensive bleeding be expected, a tampon-cannula must be used. In performing the thyrotomy the incision already made is prolonged upward from the median line and the tissues divided down to the cartilage, the cut extending upward to some point in the thyro-hyoid space. In dividing the thyroid cartilage it is customary to carry a perfectly true incision accurately in the median line, the crico-thyroid membranes being also divided as far as is necessary. In view of the extreme difficulty experienced in causing the exact coaptation of the divided thyroid after the operation, and of the serious consequences to the functions of the larynx in general and of the voice in particular which arise from the uneven apposition of the incised edges, it is desirable that some mechanical device be used to ensure the greatest possible success in this manipulation. Accident occurs not only from lack of proper care, but through the tendency of the two opposed surfaces to slide one upon the other. A simple method of overcoming the difficulty is by interrupting the continuity of the straight incision through the thyroid at some part of its course in such a way that two angles may be formed, the one acute, the other re-entrant, the points of which, fitting closely one into the other, may ensure the position of the whole. The division of the cartilage should be effected from above downward and from without inward, and may be accomplished by means of a small but strong knife in patients in whom the thyroid has not begun to calcify; in case the latter condition is present, a small, fine, probe-pointed saw, such as is used in nasal operations, will be found superior to bone forceps, which, in the opinion of many surgeons, should not be employed. A strong scissors may also be used for the purpose. The dissection having been accomplished, the wings of the thyroid are drawn apart by means of two small sharp retractors, and the interior of the larynx is thus exposed. If the thyroid has lost its resiliency, it may be necessary to make transverse incisions in the crico-thyroid and thyro-

hyoid membranes in order to obtain sufficiently wide separation of the cartilages. In closing the wound the two halves of the thyroid are

FIG. 9.

Gerster's tampon-cannula.

united by two or three sutures of fine silver wire and the superficial wound closed.

The subsequent treatment, in the main, will be such as is carried out after tracheotomy, special indications being met, and the interior of the larynx meanwhile not being neglected.

Thyrotomy as employed for the removal of malignant disease of the larynx was formerly singularly unsuccessful. In late years, however, the results obtained by it have been increasingly better, and at the present time it promises to rank as one of our most valuable aids in such conditions.

In performing operations of this class it is sometimes necessary to prevent blood from entering the trachea. This may be accomplished either by packing the latter with sponge or gauze, or by means of a device known as the tampon-cannula. This instrument is a tracheotomy-tube around the outside of which is attached a dilatable sac of India-rubber, which, being inflated when the apparatus is in position, effectually occludes the trachea above the opening of the tube. Excellent modifications of the original Trendelenburg cannula have been made by Roswell Park, Hahn, Gerster, and others.

FIG. 10.

Hahn's tampon-cannula.

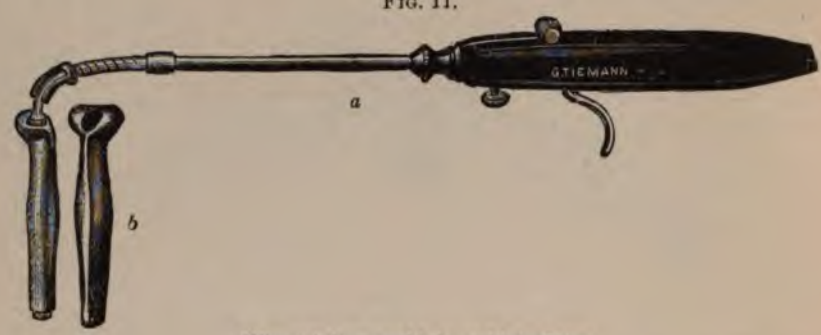
INTUBATION OF THE LARYNX.

Intubation of the larynx, as perfected and established by Dr. Joseph O'Dwyer, is perhaps one of the most valuable additions to the surgery of this department ever made. Although its prototype, catheterization of the larynx, was suggested by Hippocrates, revived by Chaussier one hundred years ago, and modified over thirty years ago by Bouchut, it was never recognized as a method of practical utility until perfected by the above-mentioned investigator.

Intubation Instruments.—A set of instruments for children under

the age of puberty consists of six tubes, of different sizes and varying in length from one and a half to two and a half inches; an introducer, an

FIG. 11.



O'Dwyer's laryngeal tube and introducer.

extractor, a mouth-gag, and scale of years. Each tube is provided with a separate obturator for the purpose of attaching it to the introducer, and this, by projecting somewhat beyond the distal extremity, produces a probe-point which prevents injury to the tissues or the detachment of pseudo-membrane during the operation. The numbers of the scale represent years and indicate approximately the ages for which the corresponding tubes are suitable. The female larynx in children as well as in adults is smaller than the male, which should also be considered in selecting the proper tube to be used.

Owing to the rapid increase in the size of the larynx at the age of puberty, the string should be left attached to the largest tube when used after this period of life, or a tube from the adult set used.

In measuring the tubes to select the proper size the heads are of course included.

The tube indicated by the scale of years is never too large to pass through any form of acute stenosis, except in rare cases of extreme subglottic infiltration of the mucous membrane, in which a smaller size may have to be used, in passing which, surrounded as it is by an unyielding cartilaginous ring, more or less force may be required. These are the only cases in which force is not absolutely contraindicated.

Having selected the tube, a strong thread of silk or linen is passed through the small eyelet intended for this purpose and the ends tied together. Braided silk is the best, and the piece used should be sufficiently long to reach the stomach and still leave a portion protruding from the mouth. The obturator is then screwed firmly on the introducer to prevent the tube from rotating while being inserted, and fixed so that the long diameter of the tube when applied and ready for use is in a line with the handle of the introducing instrument.

FIG. 12.

Mouth-gag.

Indications for Intubation.—The indications for intubation in children are the same as for tracheotomy. There is no reason why one

FIG. 13.

Extractor.

should be performed earlier than the other. The beginning of the suffocative stage is the proper time to interfere. Marked cyanosis is too late a symptom to wait for, and, besides, fatal obstruction may exist in the glottis with extreme pallor of the surface.

As far as the necessity for intubation is concerned, it matters little as to the nature of the obstruction, provided it be in the larynx and not a foreign body. It may be croup, simple laryngitis, œdema of the glottis, paralysis, spasm, acute or chronic stenosis from injury, or even a neoplasm. In the latter case it will tide over the immediate danger of asphyxia, and leave more breathing-room to facilitate the radical operation.

Method of Operating.—The person who holds the child should be

FIG. 14.

Intubation of the larynx.

seated on a solid chair with low back, and the patient placed as repre-

sented in Fig. 14. Fastening the hands in front of the chest, or thick garments in the same location, renders it more difficult to depress the handle of the introducer sufficiently to carry the tube over the dorsum of the tongue.

The gag is then inserted well back behind or between the teeth in the left angle of the mouth, and opened widely, care being taken not to do it too suddenly or to use too much force. In children who have not at least one bicuspid on the left side the gag should not be used, as it slips forward on the gums, and, besides being in the way, is liable to injure the incisor teeth. There is little difficulty in these cases in keeping the mouth sufficiently open with the finger if carried far enough to the patient's right to be out of danger of the front teeth. Allowing the child to compress the finger between the gums for a few seconds, until the jaws relax, before carrying it into the fauces, avoids the necessity for using force.

An assistant holds the head firmly, at the same time slightly elevating the chin. The operator stands in front of the patient, holding the introducer lightly between the thumb and fingers of the right hand, the thumb resting on the upper surface of the handle just behind the knob that serves to detach the tube, and the index finger in front of the trigger support underneath. Held in this manner, it is impossible to use undesirable force.

The index finger of the left hand is carried well down in the pharynx or beginning of the œsophagus, and then brought forward in the median line, raising and fixing the epiglottis, while the tube is guided along beside it into the larynx. If any difficulty is experienced in locating the epiglottis, it is better to search for the cavity of the larynx, into which the tip of the finger readily enters, and which cannot be mistaken for anything else. Once in this cavity, the epiglottis must be in front of the finger, and the latter is then raised and pressed toward the patient's right to leave room for the tube to pass beside it. The distal extremity of the tube should be kept in contact with the finger, and even directing it a little obliquely toward the right side of the larynx is necessary to get inside the left aryteno-epiglottic fold, especially in very young children. The handle of the introducer is held close to the patient's chest in the beginning of the operation, and rapidly raised as soon as the lower end of the tube has passed behind the epiglottis, otherwise it will slip over the larynx into the œsophagus.

When inserted the cannula is detached by pressing forward the button on the upper surface of the handle with the thumb, and in removing the obturator the movements required for insertion are reversed. To prevent the tube from being also withdrawn, the finger must be kept in contact with its shoulder either on the side or posteriorly.

The tube should be carried well down in the larynx before detaching it, otherwise the lower aperture will be left open and liable to strip off pseudo-membrane as it is subsequently pushed home with the finger.

The gag is removed as soon as the tube is in place, but the string is allowed to remain long enough to be certain that the dyspnœa is relieved and that no loose membrane exists in the lower portion of the trachea.

In withdrawing the tube the child is held as in introducing, and the extractor is guided along the side of the finger, which is brought in con-

tact with the head of the cannula and then pressed toward the patient's right, in order to uncover the aperture and allow the instrument to enter in a straight line. No attempt at extraction should be made until the head of the tube is felt.

Introduction of the tube must be accomplished quickly. The whole performance should not occupy more than ten seconds.

To place a tube in the larynx of a struggling, choking child in the brief space of time that is compatible with safety is a difficult thing to do, and should not be attempted, except in case of emergency, without previous practice on the cadaver or on the larynx of an animal removed and placed in a suitable position.

Expertly done, intubation should be unattended with any unpleasant detail. In the hand of the novice the opposite may be the case.

The proper time for removing the tube from the larynx will depend on the age of the patient, the character of the disease, whether of slow or rapid development, and the progress of the case. In diphtheria the younger the patient, as a rule, the longer the tube will be required. In children under two years of age it is better to leave it in seven days. When the above disease has developed slowly, and has therefore run a greater part of its course before calling for operative interference, the tube can be dispensed with earlier—sometimes as soon as the second or third day. If the case cannot be seen within a reasonable time, it is safer, if progressing favorably, to leave the tube in position for seven or eight days, and the exceptions are few in which it will be necessary to reinsert it after this time.

The tube should always be removed on the recurrence of severe dyspnœa, because it is sometimes impossible to ascertain with certainty whether it be partially obstructed or not. The best evidence to the contrary is a good respiratory murmur or numerous râles over the lower posterior portion of the lungs. Even under these circumstances the lumen of the tube may have been encroached upon. In cases refusing nourishment after intubation it is useless to remove the tube for the purpose of feeding, unless it has been in long enough to give some reasonable hope that its further use will not be necessary, as it is difficult to convince children for some time that they can swallow any better than before. If no dyspnœa recur in half an hour after the extraction of the tube, it is safe to leave the patient if not at too great a distance to be reached within two or three hours.

Accidents and Dangers of Intubation.—The most serious of the accidents incident to this operation is apnœa from prolonged attempts in unskilful hands to introduce the tube. Ten seconds is the longest time that should be occupied in each attempt if the child be suffering from urgent dyspnœa at the time. If the finger be then removed from the mouth and the patient be given a chance to get his breath, many failures to properly place the tube can be made without danger, although the expert seldom requires more than five seconds to complete the operation, except in difficult cases. In these, if necessary, an anæsthetic may be used.

If the tube has once passed on the outside of the larynx, and this is recognized before it is detached from the obturator, it is useless to try to rectify the position without first depressing the handle of the introducer, as in the beginning of the operation.

The tube may be passed into one of the laryngeal ventricles and a false passage made if care be not taken to pass it in the median line. If the patient's head be thrown too far back, the tube may also be arrested by coming in contact with the anterior wall of the larynx or trachea.

Pushing down membrane before the tube is the most serious of the unavoidable accidents attending this operation. In several such cases removal of the tube has been followed by expulsion of complete casts of the trachea, although in none of these cases was the dyspnœa relieved by the ejection of the membranes, and the immediate reintroduction of the tube was necessary because the obstruction was in the glottis.

Where the child is inclined to injure the string with his teeth, the difficulty may be overcome by passing the thread between two of the double teeth. When this plan cannot be adopted, a smaller tube than the one suitable for the age should be used, which seldom fails to be rejected if obstructed.

In the event of sudden asphyxia the nurse should hold the child head downward, at the same time shaking it or slapping it vigorously upon the chest. Serious obstruction does not seem to result from loose membrane above the tube, but extreme tumefaction of the epiglottis and aryteno-epiglottic folds does in rare cases give rise to dangerous constriction at this point, necessitating tracheotomy.

The tube is more liable to be expelled in the act of vomiting than by coughing. The larynx may be injured in attempting to remove the tube

FIG. 15.

Feeding a case of intubation of the larynx.

if the extractor be passed down beside instead of into the opening. It is important, therefore, to remember that no force whatever is required

to remove the tube, and that any resistance to the withdrawal of the extractor proves that it is caught in the tissues on the outside.

In feeding the child after intubation great care must be taken that food be kept out of the trachea, otherwise a fatal result is pretty certain. Liquid or semi-solid food may be given through an œsophageal tube or by enema. The best method is to allow the child to swallow it while his head is depressed and a little to one side.

Intubation may be employed to relieve dyspnœa or as a curative agent to effect dilatation in deformity of the interior of the larynx. In the adult it is applicable in a large variety of conditions of laryngeal stenosis, both acute and chronic, among which may be mentioned (of the former) obstruction to the larynx or œdema glottidis from any cause; injury to the larynx from fracture; incised wounds or internal violence, as from attempted endolaryngeal operation, foreign body, or the like. The chronic conditions in which it is indicated are such cases of stricture as may be amenable to treatment by the division of cicatricial bands and systematic dilatation. These include cicatricial contractions resulting from syphilis and other diseases attended with laryngeal ulceration, and from traumatisms and chronic thickening of the soft parts, in which the subglottic variety may sometimes be included. It is also useful in some cases of laryngeal neoplasm and in laryngeal paralyses threatening asphyxia.

In advanced tubercular laryngitis with obstruction the writer has used intubation with great relief to the local symptoms as well as to the dyspnœa. In fracture and other injuries of the laryngeal cartilages involving displacement the presence of the tube acts as an excellent support for keeping the displaced parts in proper position, and from its unyielding nature makes possible the application of supplementary means for supporting the parts from the outside.

The insertion of the tube is less difficult in the adult than in the child. It should be done, if possible, with the aid of the laryngoscopic mirror, although this is not absolutely necessary, the sense of touch in one expert in the operation being sufficient. The difficulty of reaching the larynx with a fore finger of ordinary length, and the greater precision with which the tube can be managed when seen in the laryngoscope, make the latter a very useful aid.

In passing the tube the larynx should first be anæsthetized with cocaine. The patient should be seated as for the ordinary laryngoscopic examination, and the tube, aided by the mirror, should be introduced as in the infant, excepting that the finger of the operator is not used as a guide. Instead of this, as is customary in the passage of any endolaryngeal instrument, the aid of the patient is depended upon to open the larynx, either by the act of phonation or of deep inspiration. The use of a mouth-gag in the adult is not required. Intubation in suitable chronic cases has practically superseded all older methods of dilatation.

The larynx tolerates the presence of the tube with great readiness, one of O'Dwyer's patients, without his knowledge, having voluntarily carried a tube without removal for fourteen months. Too long retention may injure the larynx, and is not recommended. Such a case should of course be watched, and the tube removed and reinserted as often as required by cleanliness, the condition of the parts, or the neces-

sity for more active dilatation through the insertion of a tube of larger diameter.

The instruments used for the adult are very similar to those for children, excepting that, owing to the excessive weight of metal, the larger sizes may be made entirely of hard rubber or of the latter and metal combined.

Tumors of the Larynx and Trachea.

New growths of the larynx may affect it primarily or may extend to it from neighboring parts. They may be either benign or malignant. Distinction between the two varieties is sometimes extremely difficult. The so-called tubercular or specific tumors which are occasionally seen in the larynx are not properly to be included in this class of affections, and should be considered elsewhere.

The **etiology** of benign growths of the larynx is practically unknown. Chronic congestion from catarrh, over-use of the voice, or other forms of irritation would seem to be a factor in their development, and yet there is not sufficient testimony to prove that this is really the case. Although more common between thirty and fifty, they may be observed at any age, and one form of growth, papilloma of the larynx, may be congenital.

These tumors are more common in men than in women, and are more apt to occur in those in whom similar growths are found in other parts. Their most frequent location is upon the vocal bands.

Subglottic tumors are comparatively rare, although they now and then occur. Intraglottic growths usually spring from the free border of the anterior part of the vocal bands—those above the glottis from the epiglottis and from the aryteno-epiglottic folds, the subglottic from the inferior surface of the vocal bands. The benign tumors which may occur in the larynx, somewhat in order of frequency, are—1. Papillomata; 2. Fibromata; 3. Cystic; 4. Angeiomata; 5. Adenomata; 6. Myxomata; 7. Lipomata; 8. Chondromata. Although these growths occur in considerable variety, there are but few that are seen with any degree of frequency.

Papillomata.—The papillomata, by far the most common, constitute more than half of the benign tumors found in the larynx. Papillomata are generally sessile, though occasionally pedunculated; they are often multiple, and may be distributed somewhat symmetrically. They vary greatly in size, ranging from a small, hardly perceptible granulation to a volume which practically fills the interior of the larynx. The surface is markedly uneven and of a cauliflower-like character, similar to papillomatous growths in other parts of the body. The color is usually pink, varying, however, from deep red to a dull white. This is the form of growth which Virchow has called "*pachydermia verrucosa.*"

Histologically, the laryngeal growth does not differ from other papillomas. The possibility of the degeneration of a papilloma into an epithelioma has of late years been vigorously discussed. The present position of our knowledge upon the subject appears to be—first, that the visible differences between papilloma and epithelioma are by no means clear; secondly, that a fragment of tissue removed from the upper or peripheral part of a growth may appear, under the microscope, to be

papillomatous, while at the base of the same tumor the characteristic signs of epithelioma may be present; thirdly, the possibility that a growth beginning as a true papilloma and recurring after removal may degenerate and become a true epithelioma.

Fibroma.—Next in order of frequency are the fibromata. As with the papilloma, the growths generally arise from the vocal bands. They are usually single, although not necessarily so, and may be either sessile, globular, or pear-shaped, and of a gray or grayish-pink color. The surface is generally smooth, but may be rough or irregular. They are of a decidedly firm consistency, and are composed of a mass of fibrous tissue sometimes containing myxomatous tissue, but covered with a layer of pavement epithelium, which extends as far as the point of implantation of the growths.

Fibromata show no tendency to degeneration, and are best treated by endolaryngeal removal. They rarely recur. The same may be said of cystic growths, although recurrence with the latter is somewhat more common.

Angeioma, or vascular tumor of the larynx, is occasionally encountered, and when of small size, like certain forms of papilloma, may be caused to disappear by the local spray of alcohol.

Adenoma, a somewhat rare growth, is interesting chiefly from its tendency to degeneration, in which case it becomes epitheliomatous.

The presence of an adenoma in the larynx must always be a source of grave apprehension. Occupying as it does a place upon the borderline of malignancy, the means used for its removal can hardly be too promptly applied or too radical in their nature. Should endolaryngeal measures promise unsatisfactory results, the question of radical operation (laryngectomy or thyrotomy) should be seriously considered.

Myxomas, *lymphomas*, and *lipomas*, although they have been observed in the larynx, are so rare that the data concerning them are of almost no practical value.

Cysts of the larynx, on the other hand, are not infrequently seen. They may occur extra- or intralaryngeally, and are generally situated upon the epiglottis. Occurring upon the anterior surface of the epiglottis, they may attain considerable size; intralaryngeally, they may spring from the posterior surface of the epiglottis, from the aryteno-epiglottic fold, or from the neighborhood of the laryngeal ventricle. They are characterized by their spherical form, opalescent or translucent appearance, and by the fact that there is no other chronic condition which is likely to resemble them. They may be either sessile or pedunculated. Their contents may be either serous and watery or cloudy, viscid, and colloid.

Ecchondroses of the larynx are so rare as to call for nothing more than mention.

The symptoms of intralaryngeal growth will depend upon the location, the size and the shape of the tumor, whether it is pedunculated or not, and, to some extent, upon the age and characteristics of the patient. The most commonly-observed symptom is the alteration in the quality of the voice. This, at first hardly perceptible, becomes more and more marked, until finally complete aphonia may result. Especially is this the case with new growths situated upon the vocal bands. The change

in position of a pedunculated growth may cause sudden and marked alteration in the symptoms, while a vascular growth, particularly in the early stages of its development, may demonstrate its presence or not in accordance with the state of activity of its circulation. Dyspnœa is generally wanting in the adult unless the growth should have attained considerable size. In the infant, however, it is commonly present, and may be urgent. It is generally more severe at night than during the day, is accompanied by stridor, and is due to obstruction by the growth, the inflammatory conditions excited by it, and sometimes by the attendant spasm of the glottis. It may be so simple as to pass unnoticed, or so severe as to cause death from asphyxia, varying with the location of the growth. Cough in the adult is usually not marked, and is distinctly laryngeal in character. In the child it is a frequent symptom, and often severe. It is spasmodic, and is sometimes accompanied with hæmoptysis. There is rarely dysphagia, and pain is generally absent.

The only satisfactory means for studying these growths is by the use of the laryngoscope. The expectoration will seldom give evidence of their existence.

Their **progress** is usually slow, varying with the nature of the growth. Papillomas sometimes increase rapidly, especially where a growth has been irritated by attempts at removal, by intercurrent acute affections, or by over-use of the voice.

Their **duration** is, of course, variable.

Growths may recur after removal, especially papilloma and cyst.

The **prognosis** depends upon the nature of the new growth and upon the age and general condition of the patient. It is far more serious in the infant, on account of the difficulty of endolaryngeal operation, and also because in the child the papillomatous variety is the most common. Of all the varieties of growth, a so-called diffuse papilloma is by far the most serious, on account of the difficulty in differentiating it from epithelioma. Recurrence is frequent in this, contrary to what is true in the case of other benign growths.

Treatment.—It has been said that laryngeal growths are less common now than formerly, by reason of the early and effective treatment of the subacute and chronic affections of the upper air-passages, and especially those of the nose. As to the actual treatment to be pursued in a given case, everything will depend upon the age and condition of the patient, the location, size, and shape of the growth, and, most important of all, upon its histological character.

The possibilities of the treatment of papilloma may be considered as follows: In infants, especially where the growth is interfering with respiration, the indication is clearly to remove it as speedily as possible. To this end the time-honored practice has been to perform thyrotomy and excise the growth. In many cases this has given excellent results, although it may cause permanent impairment of the voice (see section on Thyrotomy) or the development in the larynx of exuberant granulations of a troublesome character.

Danger from the growth of granulations may be avoided by the wearing of a tracheal cannula. The late Dr. Franklin H. Hooper of Boston operated successfully under anæsthesia by inverting the child's head, and, with the aid of the laryngeal mirror, entering the larynx with proper

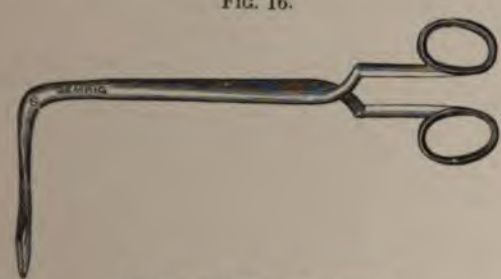
instruments, and thus removing the growth. In case of dyspnœa following such an attempt intubation or tracheotomy would be indicated.

In the adult the prominent consideration to be kept in mind is the danger of wrong diagnosis on the one hand, and the possibility of degeneration of the growth on the other. Whether a supposed papilloma is in reality a malignant growth or not, it is generally conceded that to unduly irritate such a neoplasm is hazardous. If the tumor be pedunculated, circumscribed, and located conveniently for operation, there are probably few valid objections to its removal by endolaryngeal operation. When, on the other hand, it is sessile, difficult to reach, or multiple, such attempts may give imperfect results or be followed by quick recurrence, and other methods may be indicated. Of these the one attended with the best results in the experience of the writer is the frequent daily application to the interior of the larynx of a spray of strong alcohol. Under this, persistently continued, growths of considerable size have entirely disappeared. The same treatment has given good results in the case of angeiomatous growths.

In papilloma repeated or unskilful attempts at removal, the application of caustics or of the cautery, and other measures of a harsh nature should in general be avoided. Even in some cases where thyrotomy has seemed to be indicated, rest of the larynx and the application of alcohol, as explained above, has effected a cure.

In the employment of the endolaryngeal method the larynx is first cocainized, and while its interior is being demonstrated by the laryngo-

FIG. 16.



Mackenzie's laryngeal forceps.

scope a suitable instrument is introduced into it, and the growth, or a fragment of it, seized and removed. A great variety of methods and

FIG. 17.

Stoerk's guillotine and tube-forceps.

instruments is used for this purpose. Among them may be mentioned evulsion by means of forceps (Mackenzie's, Shroetter's, Krause's); crush-

ing or "grattage" (Voltolini), by which such parts of the growth as are not removed are so injured that they either slough or are destroyed by the resulting inflammation; incision with laryngeal knife or scissors; excision by means of specially-constructed laryngeal instruments or by the cold-wire snare or the galvano-caustic loop; cauterization by means of the galvano-cautery or chemical caustics, such as chromic acid, nitrate of silver, and chloride of zinc.

Malignant Growths of the Larynx.

Malignant disease of the larynx may be intrinsic or extrinsic, primary or secondary. It may be classed under two varieties—first, the sarcomata; and, secondly, the carcinomata. The disease is primary when developed within the larynx, secondary when it attacks the larynx from without. Of the two varieties, epithelioma and sarcoma, epithelioma is by far the most common.

Etiology.—The causation of laryngeal cancer is as obscure as that of the disease in other parts. It is far more common in men than in women, and at the period of middle life. It may occur, however, in the young. Tobacco-smoking can hardly be regarded as a necessarily efficient factor in its development, although local irritations seem to favor its production. The disease in several instances has occurred in different members of the same family, suggesting etiological possibilities hitherto not explained. Here also, as in other regions, the influence of nervous depression sometimes may be observed.

Malignant disease of the larynx in its earlier stages is generally unilateral.

Sarcoma.—Sarcoma most commonly makes its appearance in the interior of the larynx, usually originating either from the true or from the false vocal bands, although it may spring from almost any part. The tumor is usually rounded, and single or somewhat lobulated. Its surface may be either smooth or somewhat papillary or rugated. The color is generally red; sometimes, however, it is grayish-yellow, and in other cases of a darker color than the surrounding membrane. Often, especially when ulceration has taken place, it may be difficult to distinguish it from papilloma, and the diagnosis can only be established by microscopical examination. When the disease is making rapid progress and destroying and infiltrating the structures in its neighborhood, it is difficult to distinguish it from carcinoma. The most common form of sarcoma found in the larynx is the spindle-celled. The round-celled variety is sometimes found, and, rarely, the alveolar sarcoma, the lympho-sarcoma, and, as in a case reported by the late Dr. E. C. Morgan of Washington, the telangiectatic myxo-sarcoma.

Epithelioma.—The favorite points of departure for epithelioma of the larynx are the ventricular bands. It may arise, however, from one of the vocal bands, from the epiglottis, or from the aryteno-epiglottic folds. Any part of the larynx may be invaded by it, but, as the disease extends, sooner or later it becomes impossible to identify the point of origin. In general, it is apt to originate from parts which are subject to a certain amount of irritation. The appearance of the growth in its first stages is variable. It may occur as a small papillary tumor, as a rounded,

well-defined swelling, or as a diffused infiltration. The first variety is often impossible to differentiate from true papilloma. The theory that the former is distinguishable from papilloma by the presence of a zone of reddened tissue around the base of the growth, which zone is wanting in simple papilloma, is absolutely unreliable. One of the most valuable of the earlier diagnostic signs is the general infiltration of the muscles in the neighborhood of the growth, resulting in the impairment or the abolition of the movements of the corresponding side of the larynx. A valuable diagnostic sign is the tendency of epithelioma to extend backward: in papilloma the opposite is true.

The method of examination by transillumination has thus far not been productive of satisfactory results, and the microscope is generally our main reliance in the study of malignant disease. Not infrequently this has proved a source of disappointment, if not of positive error. The microscopical demonstration of epithelioma will of course establish the diagnosis. Failure to demonstrate it, however, does not by any means prove that malignant disease is not present. As it may be impossible to recognize the true nature of the growth until the latter has attained a considerable degree of development, the time most favorable for operation may have been allowed to pass before the microscope has determined the actual malignancy of the case.

In its later stages the true character of the disease becomes more apparent. Its surface becomes ulcerated and covered with unhealthy granulations, and the parts are bathed in fetid pus; the surrounding mucous membrane is inflamed, and sometimes there is considerable submucous œdema. The cartilages are attacked, and sometimes those in its neighborhood become ossified, especially the upper tracheal rings in extensive epithelioma of the lower part of the larynx. The changes which may take place in the laryngeal cartilages are likely to produce marked deformities of the exterior contour of the larynx more or less plainly visible to the eye or appreciable on palpation. As the disease progresses the neighboring parts outside the larynx become involved in a process of general destruction.

When the disease is superficial, acute inflammation followed by abscess may take place, and the discharge from the latter of fetid pus or of an ichorous fluid may precede the development of the characteristic appearances of cancer.

In extrinsic laryngeal cancer the cervical glands are nearly always involved, and at an early date. In intralaryngeal disease, on the other hand, they are not affected until the growth has made extensive inroads. The glands most likely to be affected are those situated under the anterior border of the sterno-mastoid muscle. Laryngeal cancer seldom shows any tendency to metastasis.

As to the precise nature of certain neoplasms which seem to occupy an intermediate position between benign papilloma and true epithelioma —as, for instance, the *pachydermia laryngis* of Virchow—much discussion has taken place. Unfortunately, it has resulted in throwing little light upon the subject.

The early **symptoms** of epithelioma of the larynx are often most obscure. If pain be present, it is nearly always lancinating. It is only later in the progress of the disease, when the parts outside the

larynx are involved or when considerable intralaryngeal ulceration has taken place, that pain, radiating to the ears, orbit, or forehead, becomes a prominent feature of the disease. Hoarseness, if the growth is located near the glottis, may considerably precede other symptoms, and thus prove of great aid in diagnosis. The tone of the voice may also be changed through recurrent paralysis. Sometimes, after the expulsion of a fragment of the growth, marked improvement in the voice takes place. This also happens sometimes where early tracheotomy has been performed, the rest thus obtained by the larynx resulting in such amelioration of the conditions that a very decided improvement in phonation is observed. This improvement is, of course, misleading. The voice is seldom entirely lost, as it is in tubercular laryngitis. It does not improve under treatment, as in specific laryngitis. Cough is not always a prominent symptom, but if present is distinctly laryngeal, and more apt to be marked in the early stages of the disease than later, unless provoked by difficulty in swallowing. Dyspnœa develops gradually : it is occasional at first, only being evident as the result of exertion or of over-strain of the voice. As it becomes more severe a certain amount of stridor may develop, and it may become so urgent as to cause death, either by sudden closure of the glottis through swelling or by gradual asphyxia. The dyspnœa does not depend alone upon the size of the tumor, but is influenced also by infiltration of the muscles, ankylosis of the crico-arytenoid articulations, œdematous infiltration, and sometimes even by lesions of the recurrent nerves. Deglutition is difficult, often extremely painful, especially in growths in the upper part of the larynx. Pain, absent or slight in the beginning, becomes more severe as the disease advances and ulceration is developed. In the later stages it is often insupportable and lancinating in character. There is generally well-marked salivation. Expectoration, at first frothy, becomes purulent and sanguinolent. It is generally fetid, sometimes containing fragments of the growth. Salivation is often one of the most distressing symptoms of the case. Small hemorrhages finally occur, caused by the cough or efforts at swallowing, and sometimes, later, considerable amounts of blood may be lost through the ulceration of small arteries in the growth.

The *objective symptoms* must be mainly determined with the aid of the laryngoscope. External palpation of the throat in the later stages will show change in the general outline of the cartilages.

The course of laryngeal epithelioma may be marked by three periods : In the first the symptoms are those of a chronic catarrhal laryngitis ; in the second, there is the appearance in the larynx of a localized lesion, with beginning aphonia and dyspnœa ; in the third the laryngeal growth has become well pronounced, deglutition difficult, and general cachexia may have appeared. In this stage urgent dyspnœa may demand relief by tracheotomy. As a rule, this accident will precede the most distressing symptoms of cancer of the larynx, and while the introduction of the tracheal cannula will generally prolong life for months, and during the first of them almost absolute relief from painful symptoms may be experienced, suffering in the end is far more severe by reason of the extensive general infiltration of the disease, the destruction of important parts, the consequent pain in deglutition, and the acute suffering from attendant reflexes.

The prognosis is bad, and unaided the patient will surely die. The tendency to recurrence after excision will depend upon the thoroughness of the removal and on the malignancy of the growth, epithelioma being far more fatal than sarcoma. Under the very best surgical care and in properly selected cases extirpation of the whole or a part of the larynx may afford some hope in a certain proportion of these cases.

Diagnosis is often extremely difficult, if not, at least for a time, impossible, for before the character of the growth can be determined it is necessary to settle the question of the actual existence of a neoplasm. In the first place, certain of the laryngeal lesions of tuberculosis and syphilis may closely simulate malignant disease; again, eversion of the laryngeal ventricles or the presence of simple granulation tissue may be mistaken for it. Where doubt exists tuberculosis and syphilis must be absolutely excluded, the former by the usual means, the latter by the administration of iodide of potassium. The importance of the latter as a diagnostic test can hardly be overrated, and even in cases where the diagnosis of cancer seems to be clear it is well to apply it. It must be remembered that while a specific lesion will, as a rule, promptly disappear under the iodide, this will not always be the result; and, on the other hand, while it is the rule that the administration of the iodide either produces no appreciable effect upon the malignant growth or else distinctly injures the larynx, it nevertheless is often the case that during the first weeks of the giving of the iodide the laryngeal symptoms will show marked signs of improvement. This improvement in cancer, however, is transient, and certainly by the end of three or four weeks will cease. It must be remembered also that malignant disease of the larynx may coexist with tuberculosis of the lungs, and that it may also appear in a patient bearing the unmistakable signs of tertiary disease, so that, after all, neither of the diagnostic tests mentioned above is infallible.

Finally, while much has been written upon the early diagnosis of epithelioma of the larynx, we are forced, as a rule, to base our opinion upon a very limited number of signs. Of these the most suggestive are a gradually developed hoarseness, a lesion perhaps indefinitely situated upon one side of the larynx, accompanied with infiltration and more or less loss of motion of that side, and tending to progress from before backward; that is, from somewhere near the middle of the glottic aperture in the direction of the arytenoid cartilage. In true papilloma the opposite course is the rule, extension usually taking place toward the anterior commissure. Failing to prove it either specific or tuberculous, as the disease advances the appearances may become more distinct and the symptoms more typical. In many cases it is only when considerable progress has been made that we are able to rely upon the microscope. There are few conditions in which we stand in greater need of more full and accurate diagnostic knowledge.

The treatment of malignant tumors of the larynx may be either palliative or curative. The *palliative* treatment may be either therapeutic or surgical. For the former various topical applications may be made to the affected parts by means of solutions, sprays, powders, or vapors. Solutions are generally used in the form of atomized sprays, and are employed for purposes of cleansing or disinfection, to subdue pain, and to retard or overcome the progress of the growth; they may consist of antiseptics

(Dobell's solution, listerine, boracic acid, and the like), anodynes (cocaine or morphine), or caustic medicaments. The comfort of the patient may be enhanced and much local and general irritation prevented by keeping the parts strictly cleansed and by great care in the matter of feeding. By the surgical palliative treatment dyspnœa may be relieved by intubation or tracheotomy, and obstructing fragments of the growth may be removed.

The *curative* treatment may be divided into three classes—namely, endolaryngeal operation, laryngo-fissure or thyrotomy, and laryngectomy or extirpation of the larynx.

Tumors of the Trachea.

Tumors of the trachea may be benign or malignant. The benign growths, often referred to as polyps of the trachea, are generally either fibromas or papillomas. Submucous cysts, multiple enchondromas, and osteomas have been observed. In addition to these may be mentioned the various kinds of growth composed of granulation tissue which develop after tracheotomy either during the time the cannula is in position or, as occasionally happens, in the cicatrix of the wound. The dyspnœa which they cause sometimes makes necessary the reopening of the trachea for their removal and the reintroduction of the cannula.

The **treatment** consists in the removal of the growths. This may occasionally be done through the natural passages, as described by Jarvis, in cases where the growth occurs in the vicinity of the glottic aperture; otherwise division of the trachea will be necessary, the growth then being removed by some suitable instrument. In operating the head of the patient should be low, in order that the blood may not gravitate into the bronchi.

Malignant tumors of the trachea may be divided into sarcoma and carcinoma. The carcinomas are the more common. They develop generally in the upper part of the trachea, and they may be either primary, or secondary to malignant disease of the larynx, the œsophagus, the bronchial glands, or the thyroid.

The **symptoms** are obscure, and consist mainly of weakness of the voice, hard, dry, annoying cough, and progressive dyspnœa. In carcinoma pain is a prominent feature.

Examination is made by tracheoscopy, by inspection and palpation of the trachea after incision into the trachea, and by the microscopic examination of fragments which have been coughed out.

The **treatment** of carcinoma can be little more than palliative, and even tracheotomy is useless in cases where the growth is located below the seat of the tracheal opening, unless a cannula specially constructed to extend below the obstruction be used. (See, under Tracheotomy, description of "König's tube.")

Laryngectomy.

Excision of the larynx was first done in 1866 by P. Herron Watson. The experiments of Czerny (1870) on dogs demonstrated the practicability of the procedure, and also proved that the voice could be partly

restored by the introduction of an artificial appliance made for the purpose. Billroth followed in 1873 with his first operation for removing the entire larynx. Since then the operation has been performed upward of three hundred (300) times. It has been the subject of exhaustive study—in earlier years by Schierer, Baratoux, Salanione, Mackenzie, and Solis-Cohen; recently by Pinsconnat, Kraus, Taube, Wassermann, Semon, and Powers. It has found its chief indication in carcinoma, but in a few instances has been used in sarcoma, tuberculosis, enchondroma, stenosis, and necrosis. Of all reported cases, in a little over two-thirds the removal has been complete. Nearly all authors agree that a preliminary tracheotomy is necessary, in contradistinction to the views held by the earliest operators. In 171 recorded cases it was omitted in but 8. Its advantages are that the trachea becomes fixed to the anterior wall of the neck, time is saved in performing the greater operation, and the lungs have an opportunity to become accustomed to the new order of breathing.

Schüller considered it most expedient to perform tracheotomy a few weeks in advance of laryngectomy, principally for the reason that the patient may gain strength, owing to the free respiration thus afforded, and be thus better able to withstand the shock following the more important operation. He also recommended making the tracheotomy through the upper tracheal rings or below the thyroid. During the operation the greatest care should be taken to prevent fluid from passing down the trachea and into the bronchi. For this the tampon-cannula (see p. 45) or some such device should be used. Some occlude the trachea above the tube with a distended rubber balloon, sponges, or gauze packing. Imperfect closure may result in fatal pneumonia.

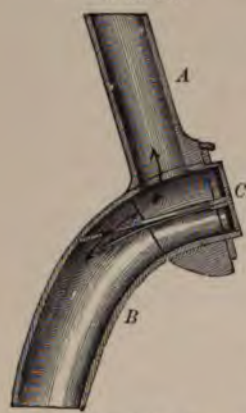
In total excision the patient lies on the back with a pillow under the shoulders, the head being somewhat low. An incision is made in the median line from the hyoid bone to a point a little below the cricoid cartilage, and a transverse incision over the hyoid bone meets this at its upper end. On exposing the larynx the sterno-hyoid muscles are drawn to one side and severed close to their insertion. The soft parts are bluntly dissected from the larynx. Vessels are ligated as encountered. After the sides of the larynx become free the inferior constrictor of the pharynx is cut close to its insertion into the thyroid cartilage. The trachea is next cut across, just below the cricoid, and drawn forward, while its lumen is well packed with sponges or iodoform gauze. Where possible, preservation of the lower half of the cricoid will aid in the adaptation of the artificial larynx. The larynx is bluntly dissected from the deeper parts until the upper corners of the thyroid are freed. Finally, the thyro-hyoid membrane is cut across and the larynx removed. The epiglottis is removed or left in place according to its condition. If it is desirable to see the inside of the larynx before removing it, the thyroid can be split down the middle and the sides held apart, while the upper end of the trachea is packed with sponges or gauze. The organ can then be removed piecemeal.

The partial operation is usually performed by splitting the thyroid down the middle, packing the upper end of the trachea, and then removing as much of the larynx as is desirable.

After the operation the upper end of the trachea is packed firmly

with gauze to prevent blood and saliva from flowing into it, and the rest of the wound stuffed lightly with an antiseptic gauze. Bardenheuer, Solis-Cohen, and others attempt to prevent foreign material from entering the lungs by elevating the foot of the bed. Nutritive enemata are given for the first forty-eight hours; then a stomach-tube may be passed through the wound into the œsophagus and gastric feeding begun. The packing is removed from the wound as often as necessary, and the parts washed with a weak antiseptic solution.

FIG. 18.



Irvine's modification of Gussenbauer's artificial larynx: A, upper tube; B, lower tube; C, the reed.

Breathing is maintained through the tracheal tube for the first three or four weeks; after that, if suited to the case, an artificial larynx may be inserted. The first apparatus of this kind was invented by Gussenbauer for Billroth's original case in 1872, and some modification of it is still in use.

Solis-Cohen objects to the removal of the thyroid cartilage when it is clearly not diseased, since dangers from the operation, immediate and remote, are much greater than when the cartilages can be left in their normal situation with the inferior constrictor muscles of the pharynx in position and many other structures left undisturbed, which in complete laryngectomy are necessarily injured or exposed. His operation removes the entire respiratory portion of the larynx, leaving the greater part of the protecting thyroid cartilages intact. Thus the gap left in the body is insignificant in comparison with that following complete laryngectomy, and a firm support is retained for the accommodation of any artificial substitute for the parts removed. The operation gives sufficient access in many cases for removal of implicated portions of the œsophagus and pharynx. In cases where the disease is limited to the interior of the respiratory tube or to the soft parts of the larynx, especially in cases not carcinomatous, it should fulfil all of the indications of entire laryngectomy without exposure to as great risks. It is applicable to the unilateral procedure as well as to the bilateral.

The detailed steps of the operation are as follows:

1. Make an incision from the hyoid bone to the lower border of the cricoid, and exactly in the median line.

2. Carefully separate the sterno-hyoid muscles.

3. Hold the soft parts aside and insert, from above, one blade of a strong, narrow-bladed cutting forceps beneath one wing of the thyroid cartilage one-fourth of an inch from the angle of junction with its fellow, and sever the cartilage vertically its entire length through to the crico-thyroid membrane.

4. Make a similar cut in the opposite side.

5. Seize the freed angular portion of the thyroid cartilage, comprising its entire respiratory contingent, with a volsellum forceps and draw it to either side, the soft parts being separated meanwhile from the inner surfaces of the detached wings of the thyroid cartilages with the handle of a scalpel.

6. Make a transverse cut to separate the cricoid cartilage from the

trachea. If the cricoid is to be retained, disarticulate the arytenoids, and then sever the soft parts above the cricoid instead of below. This modifies the next step in the operation accordingly.

7. Lift the cricoid cartilage forward and carefully separate it with the edge of the knife from the inferior cornu of the thyroid, laterally and superiorly, and then from the œsophagus posteriorly.

8. Insert a finger into the pharynx from below, and carry its tip over the epiglottis to draw the structure down.

9. Divide the thyro-hyoid membrane and the fibrous tissue still holding.

10. Lift out the exsected respiratory portion of the larynx.

The arteries likely to require ligation will comprise small branches of the superior, middle, and inferior laryngeals. Aseptic precautions should of course be observed.

A preliminary tracheotomy should be performed several days before the main operation.

The advantages alleged for the above operation, as applied in suitable cases, are—rapidity, ease, comparative safety, small size of the wound, preservation of the attachments of the thyro-hyoid ligament and the greater part of the membrane, and of the thyro-hyoid, sterno-thyroid, stylo-pharyngeus, and inferior constrictor muscles, thus leaving important functional structures retained in their normal relations for deglutition, and affording a firm, natural support for the adjustment of artificial substitutes for the larynx.

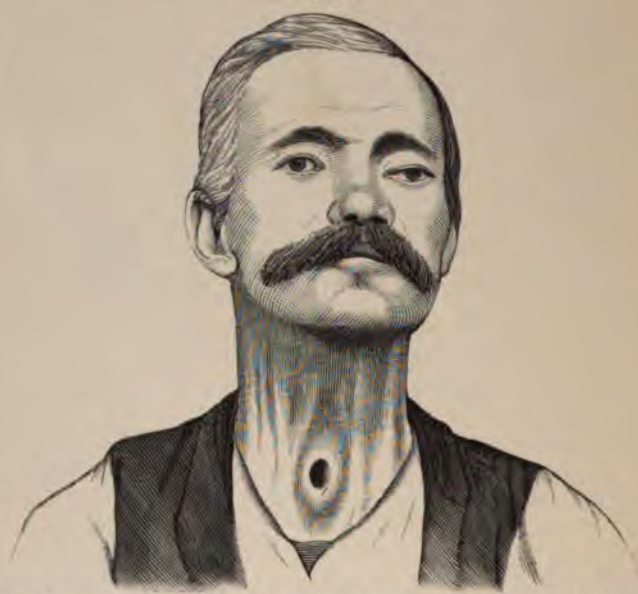
Swain reports a successful case operated upon by the method about to be described, and calls attention to the desiderata in laryngectomy—namely, complete removal of the growth, and the subjecting of patient to the minimum of risk of impairment of special function and usefulness of the part, of discomfort, and of outward deformity. The chief danger, aside from unskilful technique and accident occurring during operation, is that of septic infection or of septic pneumonia. Bardeleben found that sewing the trachea to the skin and shutting off communication with the mouth changed his statistics from four deaths out of five operations to four successive recoveries. Following the same idea, Poppert sewed up the pharyngeal wound permanently, and stitched the trachea forward into the median incision in the neck. The patient was immediately able to swallow fluids and to speak in a whisper.

Certainly the most remarkable case on record is that of the patient Hickey (Fig. 19), operated upon by J. Solis-Cohen after the above method, who three years after the operation is in perfect health, with no recurrence and with a voice capable of being heard at the remotest parts of a large public hall, communication of the trachea with the pharynx having been totally cut off. No communication existed between the pharynx and either the trachea or the exterior of the neck. The patient was able to swallow both fluids and solids, and required no tube in the tracheal opening. In this case the larynx had been entirely removed, the lips of the wound sewed together, and the wound into the pharyngeal cavity altogether closed. Thus an anterior wall to the œsophagus was made. The latter was elastic and distensible, enabling the patient to dilate it sufficiently to phonate short sentences with distinctness and with considerable strength, and even to perform an alleged act of singing.

Compared with the results of the older operations, cases operated

upon by the above method have enjoyed the following advantages, namely: speech more perfect than that secured by an artificial larynx;

FIG. 19.



Solis-Cohen's case of complete laryngectomy, with fixation of free end of trachea in cervical incision.

far better deglutition; the presence of no mechanical contrivance liable to get out of order, requiring attention and constant cleaning; no wound or disfigurement of the neck other than the tracheal wound, which later could be easily covered; no irritation of the wound from the tracheal tube or artificial larynx; and, finally, the patient was in no respect worse off than those who have to breathe through a tracheotomy-tube.

In all cases as much of the larynx should be allowed to remain as is compatible with the thorough extirpation of the diseased parts, the ultimate results of partial laryngectomy being decidedly better than those of the complete operation.

The earlier in the history of the disease that the larynx is removed, the better the probable results. As the operation is undoubtedly a dangerous one, and success with it has been thus far attained in but a small proportion of cases, it should only be applied under suitable conditions—1st, as to the character of the growth, its location, and development; 2d, as to the age and the general and mental condition of the patient; 3d, as to the surgical ability of the operator, the perfection of surgical detail, the surroundings of the operation, and the absolute intelligence and reliability of those entrusted with the after-care of the patient; 4th, the elimination of the possibility of help through other methods of treatment.

The value of serum-therapy in malignant disease of the larynx has not yet been proved, although it is to be hoped that it may yet give reliable and satisfactory results.

Injuries to the Epiglottis.

The epiglottis is the subject of inflammatory conditions, acute and chronic, due to the presence of various specific diseases. It may be injured in the case of a wound affecting the neighboring parts. It is sometimes the seat of a neoplasm, and it may suffer various deformities, either congenital or acquired. From a surgical point of view the subject may be briefly considered.

Acute affections of the epiglottis almost invariably accompany corresponding conditions of the neighboring parts, and are therefore described with them. In some of the chronic affections considerable loss of substance of the organ may take place, ending sometimes in more or less total destruction, while the presence of new growths of considerable size may seriously threaten life by inducing asphyxia.

In a wound of the epiglottis the question is whether the injury can be spontaneously repaired or whether the removal of the lacerated or diseased portion may be desirable. Experience has proved it advisable, where necessary, to remove almost any portion of this member, patients who have suffered its entire loss being able to swallow, with the exercise of a little care, without difficulty. In certain conditions of disease—as, for instance, where the epiglottis has been so deformed by contraction as to obstruct the larynx, or where it is the seat of severe tubercular disease—the removal of the offending portion may be undertaken. This is sufficiently easy, and may be effected by the use of the galvanic cautery, snare, or by properly-curved cutting forceps. New growths of the epiglottis, when situated upon its anterior face, are often easy of removal, especially where the nature of the growth is not of a malignant character.

Cysts of the epiglottis, fibrous tumors, and even carcinoma, have been taken from it with ease and with little after-irritation. The attachment of the growth in many cases is sufficiently loose to enable the surgeon to enucleate it almost without the aid of surgical instruments.

The Uvula and Soft Palate.

Diseases.—The diseases of the soft palate and uvula may be either general or local. In the first division may be grouped such as are symptomatic and merely the local manifestation of a general condition, such as measles, scarlet fever, diphtheria, syphilis, tuberculosis, and lupus. Although the local lesion in any of the above affections cannot compare in importance with the general disease, there may arise certain conditions under which the throat affection may become of decided importance, as will be seen in chronic inflammation, diphtheria, and syphilis of the parts. Local affections of the soft palate include the various inflammations which may attack it, such as simple hyperæmia, acute, subacute, and chronic catarrh, œdema, and phlegmon, as well as general relaxation, dilatation of the superficial blood-vessels, paresis, new growths, and congenital malformation.

Inflammation.—Acute catarrhal inflammation of the uvula and soft palate presents the symptoms common to other similarly affected parts. Œdema of the submucous connective tissue and of the muscular tissue beneath may occur, giving rise to an acute prolapsus of the uvula and attended with much irritation and discomfort.

Phlegmonous uvulitis is characterized by the greater intensity of the accompanying inflammation. The uvula is very much swollen and reddened and the pain is excessive. The sensation is of a heavy, voluminous body in the mouth which in the act of deglutition gives rise to lancinating, almost unbearable, pain. Respiration, besides, is more or less seriously impeded.

MALFORMATIONS of the uvula are not infrequently observed. In addition to asymmetry or absence of the part, two common varieties of deformity are met with—viz. congenital elongation or undue length and the condition known as bifid or double uvula. In the former the whole structure, including the muscular tissue, is lengthened to a greater or less degree beyond the normal limit, the amount of elongation in some recorded instances being incredible. A case is mentioned where persistent cough and attacks of suffocation were due to a uvula four inches in length. At its lower extremity there was a large expansion which had been of service in preventing the uvula from passing into the larynx.

Congenital elongation of the uvula has been observed as hereditary. The condition is easily remedied by the amputation of the redundant part.

Bifurcation, a result of arrested development is, quite common. To relieve the more pronounced cases the tips may be removed, the inner aspect of each denuded well up to the base, and then brought together.

Relaxed uvula is usually the result of chronic inflammation of the soft palate or of the neighboring parts. The causes which are producing it should, if possible, be relieved, and, if it be much elongated, if it be a source of irritation, if it refuse to retract under the influence of local treatment, it should be shortened.

At the present day amputation of the uvula is practised with an increasing degree of discretion, as some reproach has been cast upon it by the indiscriminate and clumsy manner in which it has sometimes been done. The simplest and best instrument for its performance is a pair of long-handled scissors, having the blades curved sideways toward the right hand, and one blade slightly hooked at its tip so that the uvula may not slip from its grasp. A holder, made on the principle of the thumb-forceps and about eight inches in length, possesses the advantages over other forceps that it has not the inconvenient scissors-handle, that it may be held firmly and with great steadiness by allowing its proximate end to rest in the hollow between the thumb and fore finger, the whole hand meanwhile being steadied by resting the fourth and fifth fingers against the patient's chin, and, finally, that in applying the scissors the forceps may be used as a guide.

In operating, the patient's tongue should be held down by himself or by an assistant with a tongue-depressor, and he should be instructed to breathe quietly, so that the throat may be relaxed and the pharyngeal region kept in a quiescent state. The amount necessary to be removed having been carefully estimated, the uvula, under cocaine anæsthesia, is grasped by the forceps at a point below the proposed line of incision and held carefully in position, care being taken to avoid stretching it, the result of which is to drag the mucous membrane so far downward that in removing it the parts beneath are denuded and the healing process thereby greatly retarded. The scissors, carefully guided by the hand

and eye of the operator, are then applied and the separation of the redundant tissue is completed. The same result may be obtained by means of the Jarvis snare, in the use of which it is only necessary to seize the part to be removed in the loop of the écraseur without the aid of the forceps. This latter method is not painful if cocaine anæsthesia be employed, and it is sometimes convenient and effective. Should there be any fear of exciting undue bleeding, the galvano-caustic loop may be substituted for the cold snare. The line of incision should be directed from below obliquely upward and backward, in order that the wound may be exposed as little as possible in the act of deglutition. Pain will vary greatly in different cases. In a thick, congested, hyperæsthetic uvula it may be severe and healing protracted. The amount of relief possible from this simple procedure is sometimes remarkable, the symptoms, local and reflex, vanishing quickly, the general health returning to a normal basis, and the voice gaining markedly in quality and power. In rare instances hemorrhage more or less troublesome in its character has resulted from this operation.

NEW GROWTHS.—Papillomatous growths, generally of small size, but sometimes of sufficient dimensions to cause irritation, are occasionally seen upon the uvula. They are usually located near its free extremity, and may be either pedunculated or sessile. These growths seem to occur more commonly in patients suffering from tubercular disease or syphilis. They are also found independently of any diathesis. Myxomata of the uvula are occasionally seen. Angeiomata or vascular growths may also occur.

Occasionally a benign growth may be attached to a pedicle so long that the tumor itself escapes observation until drawn upward and forward. In all of these cases amputation of the uvula above the site of the growth is at once successful in relieving the difficulty.

Malignant growths of the uvula and soft palate are occasionally encountered, usually, however, as an extension of the disease from adjacent parts.

Syphilis, tuberculosis, lupus, and lepra of the velum and uvula are met with, the first often, the last three rarely.

SYPHILIS OF THE VELUM PALATI.—The occurrence of the primary lesion of syphilis, although now and then observed upon the tonsil, is, upon the velum, almost unknown.

In the secondary manifestations of the disease, however, the soft palate and uvula are frequently involved. The conditions presented are those commonly seen in the adjacent parts of the oral cavity, and include simple erythema or congested patches symmetrically disposed, submucous infiltration, mucous tubercles, followed by mucous patches or by the formation of condylomata. A peculiar feature of these manifestations is their symmetry, which, as is often seen upon the uvula, is so well marked as to attract the attention of the observer. Early in the disease the congestion may be so indistinct as to escape observation. Gentle irritation, however, will often cause the distinctive character to be intensified. Considerable rise of temperature often accompanies the first appearance of this form of sore throat.

The tertiary form of syphilis may occur in the soft palate at any period of time beyond two years after the primary infection. It is

characterized by true ulceration or loss of tissue, and is the result of the degeneration of gummatous deposit.

The effects upon the velum palati of tertiary syphilis are often most disastrous. A frequent seat of gummatous infiltration, its exposed situation, and delicate texture render it liable to serious injury as the result of tertiary ulcerative processes. These are often characterized by extensive loss of substance, and are followed by marked cicatricial contraction and the formation of adhesions between the remaining tissue and the neighboring soft spots, which not only destroy the velum itself and abolish its functions, but result in a closure or a shutting off of the upper pharynx from the lower. This closure is more or less complete in proportion to the extent of adhesion present, and may vary from a slight narrowing of the aperture, due to adhesions at the outside angles of the velum, to absolute occlusion. Two varieties of cases may be described: 1. Those in which simple ulceration has taken place at or near the margins of the velum, without material loss of substance. In such cases, the adhesions being limited to a somewhat narrow band of union between the edge of the velum and the pharynx, and the greater part of the velum itself being intact, the prognosis is good. 2. When the loss of substance has been considerable, and when the soft palate has become extensively adherent to the pharynx, relief becomes a matter of extreme difficulty, and in many cases is next to impossible by any known plan of treatment. In the worst cases the whole posterior surface of the velum and the superior surface of the soft palate seem to be firmly incorporated with the posterior pharyngeal wall. In these cases the roof of the mouth and the posterior wall of the pharynx seem to be continuous, the line of adhesion not being traceable in the confused mass of cicatricial bands which represent the original structures, and which are sometimes disposed in the shape of irregular vertical digitations, between which there may be one or more places in which the adhesion is incomplete and through which a probe may be passed. Should the opening be invisible upon inspection of the pharynx, it may generally be demonstrated by forcing air into the nasal cavities by means of a Politzer inflator, observing meanwhile, from the presence of bubbles in the pharynx, any points of exit which may exist.

The results of extensive adhesion of the velum to the pharynx are most distressing, and may be summed up as follows: 1. Mouth-breathing, with all of its attendant evil results; 2, impairment of the quality and tone of the voice; 3, interference with drainage from the nasal cavities and naso-pharynx; 4, consequent upon this, loss of hearing from irritation of the Eustachian tube and the almost inevitable occurrence of serious middle-ear disease; 5, loss of the sense of olfaction, owing to the lack of air-current through the nasal passages necessary to bring the odoriferous particles in contact with the olfactory membrane. When the passage to the lower part of the pharynx is contracted, there is sometimes dysphagia and dyspnœa.

The treatment of this condition consists in the attempt to separate the adherent tissues, and to establish, more or less perfectly, communication between the upper and lower pharynx. To carry out this design with success is one of the most difficult problems of surgery. Perforation of the velum through the breaking down of gummatous deposits is

said to be a cause of serious danger to that organ, since, having thereby lost to a greater or less degree its muscular vigor and resiliency, it is liable to swing backward against the pharynx instead of being held at a normal distance from it, so that perforation renders it all the more liable to subsequent adhesion. The common mechanism by which adhesion takes place, however, is the same as is observed in the cicatricial union of the fingers following burns. Despite all possible care, the cicatrizing surfaces begin to unite at the bottom of the angle between the members, and the process of adhesion continues until the denuded surfaces, throughout their whole extent, have become firmly joined to each other. In these cases the first care should be to prevent adhesion by checking with all possible diligence the appearance and spread of ulceration upon the parts. Not only should the iodide of potassium be freely administered, combined, if necessary, with mercury, but local application of nitrate of silver or the acid nitrate of mercury to the ulcers if they be spreading, or, if indolent, of a solution of sulphate of copper (gr. iij–℈j), should be made. Failing in this, means should be used to keep the ulcerated surfaces apart. For this purpose several methods have been proposed, but as they apply as well to the separation of the parts after operation, they will be described later.

The **prognosis** as to the results of operation must depend largely upon the extent of deformity present in a given case. Where the degree of adhesion is comparatively slight the adherent surfaces may be separated by means of a small, flat knife or with the galvano-cautery. As the tendency to reunion is inevitable, it will be necessary, after operation, to use the best possible means for preventing this. Dilatation of the parts may be attempted by repeatedly drawing forward the remnant of the velum by means of a palate-hook, used by the patient himself; or, as has been suggested, a piece of tape may be passed through each nostril and out at the corresponding angle of the mouth, the velum being thus drawn away from the posterior pharyngeal wall; or a piece of metal or of hard rubber, shaped to fit the space between the velum and the pharynx, may be suspended from two stout threads passed forward through the nose and tied so as to hold the plate in position. This, worn constantly, serves as a permanent dilator. One of the best methods is that proposed by Nichols, who makes two openings, if none exist, the one near the median line, and the other as near as possible to the lateral wall of the pharynx. Into these he passes a seton, which is kept in place until the outer hole has cicatrized. When this is accomplished the adhesions between the two openings are separated, and the process, if necessary, repeated on the other side. The angles of the wound having been covered, the remaining surfaces heal without readhering. For the seton several strands of coarse, soft-woven silk may be used, or a single strand may be inserted, over which a piece of fine india-rubber tubing can be carried and left in the wound.

Where the degree of deformity is excessive, the best that has been accomplished is to widen the channel of communication between the upper and lower pharynx sufficiently to allow the nasal secretions to be drained away. This has been done by applications of the galvano-caustic knife, followed by constant dilatation, practised by the patient himself by means of some form of sound. By the last-mentioned method

an opening of considerable size may be maintained. Preliminary to operating upon such a case much aid may be secured by passing a sound backward through the nose and demonstrating the lowest and most superficial point of the pharyngeal pouch. By cutting against the point of the sound used as a guide an entrance may generally be effected.

Finally, it must be said that, although the prognosis as to relief of adhesion of the soft palate to the pharynx is often most unpromising, much may be done to help the sufferer by skill, ingenuity, and unremitting patience in the application of the means already at hand.

With the best that can be done, it must be admitted that these cases are often extremely difficult to handle and disappointing in their results. Owing to the great irritability of the pharynx sometimes present, operation in these cases must be done under anæsthesia.

Not the least unpleasant result of operation is the hemorrhage which not infrequently attends such attempts, sufficient sometimes to call for the use of a tampon-cannula.

Ludwig's Angina.

This affection has been variously called "gangrenous induration of the neck," "submaxillary bubo," "sublingual abscess or phlegmon," "subhyoid phlegmon," "infectious submaxillary angina," "erysipelas of the pharynx," "diffuse cervical abscess or phlegmon," "cynanche cellularis maligna," and "cynanche sublingualis rheumatica." For years the specific individuality of the disease has been in controversy. The earlier writers all followed Ludwig in asserting the former. Semon declares that the affection is a septic sore throat with a peculiar localization, differing in no wise etiologically from phlegmonous pharyngitis, erysipelas of the pharynx, or acute œdema of the larynx, all of these conditions representing merely different degrees of virulence of one and the same infecting agent. The question of primary development and localization depends in all probability upon the seat of the original infection, and it is impossible to draw at any point a definite line of demarcation between the purely local and more complicated or between the œdematous and purulent forms. Semon thus applies clinically general bacteriological principles to a certain group of septic inflammations, harmonizing to a certain extent former conflicting views.

Definition.—The disease is defined as a diffuse phlegmonous inflammation of the floor of the mouth and of the intermuscular and subcutaneous tissue of the submaxillary region, which may end in gangrene, abscess, or resolution, and which sometimes prevails as an epidemic. To this the word "infectious" should be added. Its possible epidemicity can be explained by the simultaneous exposure of the patients to the same septic influence. The disease is said to occur most frequently during outbreaks of diphtheria. This has not been proved. As a sequel to or complication of infectious maladies it has been observed more frequently perhaps with typhus fever.

Pathology.—While admitting a septic causation, as yet no special pathogenic germ of the disease has been found. Bacteriological examinations appear to have been made in a surprisingly small number of cases, and thus far only the ordinary microbes of suppuration have been found. It is only

in respect to the site of the disease that it may lay claim to a special consideration. The location in which the pus originates is, in fact, a triangular pyramidal space with the following boundaries: the apex (below) corresponds to the point where the mylo-hyoid muscle borders the genio-glossus; the base (above) stretches along under the tongue; the external wall (oblique) is made up of the internal face of the inferior maxilla and the mylo-hyoid muscle; the internal wall (vertical) by the genio-glossus and hyo-glossus. The mucous membrane of the floor of the mouth and the eighteen or twenty glandulæ sublinguales close its cavity on top. It is through this channel probably that the infection gains entrance, so that the affection of the submaxillary gland is in many, if not all, instances secondary.

Symptoms.—These are constitutional and local. The former are in general those of pus-formation—chill, fever and sweating, rapid pulse, general bodily pains and malaise, constipation, scanty and high-colored urine—but it is important to bear in mind that the pathological process may also give a distinctly asthenic type of symptoms with an overwhelming prostration and low temperature, as sometimes seen in the eruptive fevers.

The *local symptoms*, in addition to the prominent swelling of the neck, present the following diagnostic points:

1. A wooden-like induration of the affected region sharply defined from the surrounding normal tissue.
2. The thrusting forward and upward by the accumulating inflammatory products of the tongue toward the palatal vault.
3. Severe dyspnœa with the attendant danger of laryngeal œdema.
4. The pressure of a hard pad or button-like swelling at the dental arcade on its inner aspect. All of the foregoing occur together with the ordinary features of a phlegmon. Swallowing is painful, if not impossible, on account of the muscular infiltration, and the patient may not be able to open the mouth.

Prognosis.—The condition is always a grave one. Out of 58 tabulated cases taken as recorded in literature, there was a mortality of about 57 per cent. The chances of recovery depend on the previous state of the system, the type of disease, the asthenic form being particularly unfavorable, and especially upon the prompt and early recognition of this form of phlegmon. Causes of death are most frequently sepsis and suffocation from pressure or from laryngeal œdema.

Differential Diagnosis.—Three conditions require to be excluded. These are:

1. Osteomyelitis of the lower jaw; but here there is no limited focus of inflammation; the entire bone is affected, the inflammatory process is more generalized, and the subhyoid region is rarely involved.
2. Simple adeno-phlegmon of the submaxillary gland. Here the inflammation is superficial, the gland and its capsule are easibly accessible, there is no wooden hardness, superficial incision gives exit to pus, and the process is localized at the outset behind the internal face of the maxilla.
3. A rare condition known as Fleischmann's hygroma. This is sudden in onset, is in the median line, and without either constitutional or local evidences of inflammation.

Treatment.—Modern surgical therapy enables the treatment to be summed up in three propositions—*first*, early and ample incision; *second*, subsequent rigid antisepsis; and *third*, constitutional support. The condition is one of ptomaïne-poisoning. Its cause must be removed and the effects already produced strongly combated.

Of 58 cases, a spontaneous evacuation of the inflammatory products occurred in 3. Of these, 2 recovered and 1 died, discharge in the latter having been followed by a recrudescence of all the symptoms, especially dyspnœa, and death having ensued apparently from suffocation. It is recorded in one instance that there was a gradual disappearance of the cervical swelling with recovery. In 15 of the series of 58 no statement is made with reference to treatment, and of this group all but one died.

Continuing the analysis of the same series, we find that incision was followed by the escape of pus in 21; in 3 others no pus escaped; in 2 pus appeared on the second and fifth days respectively; in 5 the results of incision are not stated; and in 1 the incision was made by the cautery.[1]

Gerster points out that the object of incision is not so much to evacuate pus as to relieve tension. He adheres to the modern view that the submaxillary gland is the focus of mischief, and attaches practically a pathognomonic importance to the fact that pressure over the œdematous area rarely elicits pain except directly over the gland. Even if the patient is unconscious, such pressure will cause unmistakable signs of distress, and if such evidences appear delay is not longer justifiable.

For operation general anæsthesia is necessary, for the operation is an exploration into deep tissues, and those, too, in close proximity to important vessels and nerves.

Fluctuation is delayed because the pus is confined within a fibrous capsule. Early incision may discharge nothing more than ichor, while pus may form later, but in any event tension is relieved, and the subsequent danger of pressure, suffocation, or laryngeal involvement is much lessened.

Delorme advocates a deep lateral incision over the submaxillary gland, but this is a blind method, and one very likely to miss the purulent focus altogether. Operation through the mouth is to be condemned, as it allows the possibility of secondary infection, because subsequent irrigation cannot be carried out with any degree of thoroughness. External incision in the median line of the neck may also escape the inflammatory deposit.

Preference is unhesitatingly given to Gerster's suggestion to lay bare by a careful dissection the entire submaxillary region before making the incision designed to evacuate the ichorous or purulent accumulation. Such incision to be effective must penetrate the mylo-hyoid muscle, for it is on the distal side of this structure that the mischief originates.

Subsequent irrigation with bichloride (1 : 1000) or boric acid (1 : 100) is to be thoroughly carried out, and stimulants—quinine, etc.—systematically administered according to the indications of each individual case. Ice-water coils to the neck and all similar devices can be of service only in the very earliest stages of the malady, and at best must be looked upon only as temporizing measures. Hydrogen-peroxide solutions may assist in the separation of the sloughs.

[1] See Newcombe, *Transactions American Laryngological Association*, 1895.

Congenital Malformations of the Pharynx.

Congenital malformations of the pharynx are of rare occurrence. Fistulous openings, which are evidently of this origin, are sometimes found, communicating with the pharynx or the trachea. The condition has been described as an embryonic cleft-formation, and has sometimes been called fistula colli congenita.

Of congenital malformations of the neck the pharyngeal fistula is by far the most common. To this place belong all fistulæ which open into the pharynx or in its direction. They are divided into two varieties, the complete and the incomplete. They are apt to be hereditary, and more than one member of a family may be affected. Again, it has been observed that cleft-formations in other parts of the body have occasionally been associated with this variety of malformation.

Pharyngeal fistulæ are, as a rule, unilateral, and they occur more commonly on the right side than on the left. They are usually incomplete, and are found with equal frequency in males and females. Their external opening is usually found upon the side of the neck, anywhere in the course of the line represented by the sterno-clavicular articulation and the angle of the jaw. Rarely they may open in the median line over the larynx or trachea. They may present the ordinary characteristics of a congenital fistulous opening, or, in consequence of inflammatory irritation, may be covered with granulations and hardly large enough to admit a probe. The internal opening is generally found in the lateral wall of the pharynx, behind the cornu of the hyoid bone and near the tonsil, or in the pharyngo-palatine arch. The canal varies in length and in diameter, is usually somewhat tortuous, and sometimes so much so as to be almost impassable to a probe. Its diameter is always greater than that of the external opening, and it can be much increased by retained secretions when, for any reason, the opening has become stopped. The walls of the passage are thick, and they excrete a discharge which contains pavement epithelium.

Diagnosis.—The diagnosis may be made from the history of the case, the position of the opening, and the course of the canal as demonstrated by the probe. These data will differentiate it from fistulæ acquired from injury or as the result of suppuration. The existence of an internal opening may sometimes be demonstrated by the passing of a fine probe or by the injection through the canal of a colored liquid. It is sometimes hard to demonstrate.

Treatment.—The treatment of these cases is sometimes very difficult. The principle upon which it is based depends upon the destruction of the epithelium lining the canal. This may be accomplished by caustic injections, notably those of iodine; by direct cauterization with the galvano-cautery, or by the radical extirpation of the fistula throughout its entire extent. Operation is often difficult, and from the anatomical importance of the region by no means free from danger.

Retropharyngeal Abscess.

Circumscribed abscesses of the pharynx are generally due to the breaking down of lymphatic glands. Their situation in the neighbor-

hood of the pharynx causes them to manifest peculiar symptoms and tc be attended with special dangers. Three varieties may be recognized—the retro-, the lateral, and the anterior pharyngeal.

Chronic abscess of the retropharynx is a common disease in the young. It is a serious condition, threatening as it does the life of the patient, but one which is, as a rule, entirely remediable by the prompt application of proper treatment.

Etiology.—Age is generally the predisposing cause, but, although almost invariably found in infants, it has occasionally been observed in adult life. A debilitated condition in general, chronic cachexia, and the influence of certain infectious diseases may all predispose to it.

A serious form of retropharyngeal abscess is sometimes found in persons suffering from caries of the cervical vertebræ.

Symptoms.—The early symptoms of retropharyngeal abscess are similar to those resulting from ordinary pharyngitis. The pharyngeal inflammation, however, continues, and, instead of subsiding, the swelling continues to increase. The glands of the neck in the neighborhood are sometimes enlarged. The attack is sometimes sharp and well pronounced, and in other cases it is slower in its course; the symptoms are less conspicuous and the development of the condition is insidious, the progress of suppuration being very slow. The first variety is more common. Its onset is characterized by high fever, headache, and vomiting, sometimes by chills and convulsions. The symptoms of the acute sore throat are more or less severe, with considerable pain in swallowing. Another prominent symptom is dysphonia. Pain is especially marked in the back of the throat and is increased by movements of the head.

Examination.—The pharynx appears red, with considerable swelling in the posterior wall. The latter is usually not symmetrical.

Palpation.—Early in the case palpation may give ineffective results, but later a doughy feeling or distinct evidence of fluctuation will be found. Pus is developed in from four to eight days, and sometimes its evolution is very rapid. Gangrene has been observed, but such severe forms of the disease would hardly occur unless in greatly debilitated patients.

The subacute form of retropharyngeal abscess is more frequent than the preceding, and is generally due either to tubercular degeneration of the glands or to necrosis of the vertebræ.

Prognosis.—The prognosis of chronic abscess is good. That of acute abscess depends entirely upon treatment. The disease, if left to itself, is almost sure to be fatal. When the abscess is promptly opened there is little difficulty, as a rule, in saving the patient's life. Spontaneous opening seldom occurs, so that danger from suffocation is great. Otherwise the patient will probably die from such a complication as pharyngitis, pneumonia, or pleurisy. In exceptional cases the abscess is diffused through the deep tissues of the neck, and may often reach the mediastinum. Such complications, of course, are very serious, and, even although free drainage may have been established, the spontaneous opening of the abscess, especially if it occur during sleep, may cause almost instant death by asphyxia.

Treatment.—The treatment of retropharyngeal abscess in the early stages of the disease should be that applicable to similar acute inflamma-

tory conditions of the pharynx. Upon the earliest detection of pus, however, free incision should be made through the posterior wall of the pharynx into the abscess, the most prominent part of the swelling or that at which the fluctuation is most distinct of course being selected. In performing this little operation great care must be taken to prevent the pus from gravitating into the trachea. To this end the pharynx should be clearly demonstrated, full preparation made for the operation, and the instant the knife is withdrawn the patient, if an infant, should be inverted to prevent the escaping pus from entering the larynx. In the adult the patient's head may be caused to hang over the edge of a table. Anæsthesia is contraindicated.

Lateral abscess of the pharynx may closely resemble phlegmonous tonsillitis. It differs, however, from the latter disease in being caused by the suppuration of a lymphatic gland. The symptoms are analogous to those of retropharyngeal abscess, excepting that dysphonia is less severe. Symptoms caused by irritation of the accessory or pneumogastric nerves may sometimes arise.

External inspection of the neck may demonstrate the presence of a localized swelling in the neighborhood of the angle of the jaw, while an inspection of the pharynx will show a condition hard to differentiate from acute tonsillitis.

This form of abscess is commonly acute, and is generally recovered from. Its proximity to the great vessels of the neck, and particularly the carotid, renders it a source of some danger to these organs.

Treatment.—Incision is not always possible through the wall of the pharynx, and in many cases it will prove easier to reach it from the outside. External incision has been highly recommended, because it is the best means of thorough evacuation and treatment of the cavity. Where pus has migrated into the muscular planes of the neck this treatment will of course be required. Hemorrhage from one of the great blood-vessels from erosion of its walls is almost necessarily fatal. Nevertheless, in such a case the common carotid has been successfully tied.

Foreign Bodies in the Pharynx.

The consideration of this subject properly belongs with that of foreign bodies in the œsophagus, although there are some features of it which must be taken up with special reference to the pharynx itself. The variety of substances which become impacted in the pharynx is almost infinite. Small objects, such as bristles, fish-bones, and the like, are apt to be lodged in the tonsil or entangled in the adenoid tissue at the base of the tongue. Larger substances will be more commonly found either in the glosso-epiglottic or the pyriform sinuses. The sensations and opinions of the patient as to the existence of a foreign body in the pharynx are by no means reliable, hyperæsthesia of the pharynx often simulating the latter condition.

Examination should be conducted by the aid of a strong light and cocaine anæsthesia. Irritability may be relieved by the swallowing of ice or very cold water. For direct inspection of the throat it is sometimes useful to assist the action of the tongue-depressor by pressing upward the thyroid cartilage, thus bringing the different parts into view.

Failing to discover the object in this way, the laryngeal mirror should be used. The practice of digital examination of the throat, although valuable, should be made a last resort, on account of the reflex irritation which it excites.

A small object in the tonsil may easily escape detection. It is always well to sweep a probe gently over the surface of the gland, and to examine with a rhinoscopic mirror behind the palatal folds. The extraction of one object does not preclude the possibility of others remaining.

The **treatment** depends upon the immediate extraction of the offending subject, with means at hand for the proper demonstration of the throat and suitable curved forceps to accomplish removal. Where the body is lodged very low in the pharynx and is of a shape which renders its extraction through the natural passages impossible, entrance to the pharynx from the outside may be demanded. The continued presence of an irritating body in the throat may give rise not only to dangerous local symptoms, but to cough and local irritation of a distressing character, causing the general condition of the patient to rapidly deteriorate.

Pharyngocele.

This condition consists of a dilatation of the walls of the pharynx, usually at its deeper part. It may originate from the long-continued presence of a foreign body or from other accident, or it may arise without apparent cause. The dilatation may extend downward, between the œsophagus and the vertebral column, or outward.

The **symptoms** are dysphagia, the presence of an elastic tumor on the outside of the neck, which may be caused to disappear by pressure, abnormal sensations in the throat, and the occasional ejection of undigested food without symptoms of nausea, this act being followed by relief.

The **diagnosis** will be obvious from the above symptoms.

The **treatment** may be either palliative or radical. For the former, in the case of lateral diverticulum, the pharynx may be supported during deglutition either by the hand or by a suitably-adjusted collar. If the mouth of the sac be visible, it has been suggested to produce closure of the orifice by means of the galvanic cautery. Excision by external operation has also been successfully practised.

Adenoid Hypertrophy at the Vault of the Pharynx.

Adenoid hypertrophy at the vault af the pharynx may be defined as a condition of chronic enlargement of the collection of lymphoid tissue at the vault or roof of the retronasal space, otherwise known as Luschka's tonsil, the pharyngeal, or the third tonsil. To Prof. Wilhelm Meyer of Copenhagen belongs the credit of having estimated it at its true value and of having proposed efficient means for its relief.

As commonly met with, it is of two varieties. In the first the adenoid element may be associated with more or less fibrous tissue; in the second the latter is but feebly represented. The size of the growth may be so great as to practically fill the retronasal space, or, on the

other hand, it may be so small as to make it difficult to determine whether or not its condition is pathological. It may be confined strictly to the vault, or be diffused over the posterior and lateral walls of the pharynx, or it may exist upon the posterior wall of the pharynx alone, either in a large, well-aggregated, tumor-like mass or in more or less thickly scattered elevations.

FIG. 20.

Position of adenoid enlargement as commonly located in the upper pharynx.

FIG. 21.

Boy aged seven. Mouth-breather, from obstruction of the pharynx; open mouth; vacant expression; pinched nostrils; dull eyes; drooping eyelids; sunken chest; round shoulders (Hooper).

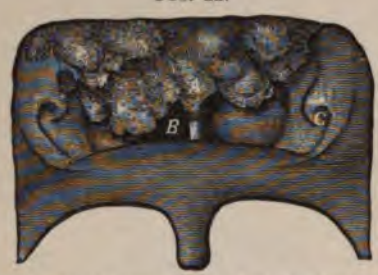
The **symptoms** of adenoid hypertrophy at the vault of the pharynx are, first, those due to mouth-breathing—namely, a dull, stupid expression of the face, anæmia, drooping of the eyelids, open mouth, projecting teeth, arched palate, pinched nostrils, and the deformity of the chest known as "pigeon breast." Again, there is mental dulness, loss of hearing, nasal obstruction, with all of the distressing symptoms of which it is the cause, defective speech, and, generally, almost constant catarrh, the secretions from which are swallowed, with the result of producing indigestion. The occurrence of reflex effects is shown in frequent headache, irritative cough, laryngeal spasm, and other neurotic symptoms, including in some exceptional cases such extreme results as chorea and, it is said, epilepsy. Even in the infant it may be suspected through the presence of mouth-breathing, snoring, and a marked inability to perform the act of nursing.

One effect of the obstruction to nasal respiration is worthy of special consideration—namely, the permanent deformity of the bony framework of the nose and hard palate which generally accompanies it. While with the angular upper jaw and high-arched palate it is sometimes possible to find a normal nasal septum, the contrary condition is the rule.

Some of the worst exhibitions of septal deformity met with are associated with obstruction to free nasal respiration. The well-known experiment of occluding one nostril in a growing rabbit has proved conclusively that marked asymmetry may result, and there is every reason to believe that similar causes in the young child may be followed by like

deformities, and that, too, at a very early period in the child's history. Deformity of the septum and of the other bony structures of the nose may arise early in life from obstruction to nasal respiration, due to adenoid hypertrophy in the retropharyngeal space. In consequence, during the period of constructive activity, impeded nasal respiration is a constant menace to the healthy development of the osseous structures of the nose. The sinuses adjacent to the nose, too, will be undeveloped, and in consequence the whole conformation of the face may be materially changed.

FIG. 22.



Adenoid hypertrophy at vault of pharynx (Lefferts).

Finally, as has been stated, nervous symptoms innumerable, both direct and reflex, must be recognized and their true origin traced, the general principle being conceded that the disease in question has extraordinary capabilities in producing them, and that it is difficult or even useless to attempt to control them without removing their prime cause.

Considering these things, it becomes important to secure the early recognition of the necessity for treatment in such cases, and to see that it is promptly and efficiently carried out. The treatment in these cases must depend in some degree upon the nature of the growth, the size to which it has attained, and upon the age of the patient.

In a few instances, where the disease is acute or subacute, where the tissue is soft, and where the growth is small, or, finally, where the patient is old enough to submit to local treatment, the application of resorptives and the administration of alterative and tonic medicines, together with careful attention to hygiene, may accomplish a cure. Often, however, these means will be found unsatisfactory. In the surgical treatment of this condition two general classes of operations are employed. The first of these is the destruction of the growth by means of caustic substances or the galvano-cautery, and the second, and by far the most effective, its forcible removal by means of some surgical operation. With the first method we have seldom been able to attain as satisfactory results as with the second, although in certain exceptional cases, where the amount of tissue to be removed is small and its situation remote, it is both convenient and efficient.

By far the larger number of the more severe cases, however, will demand removal by cutting or tearing process. To meet the requirements of this many instruments have been devised, some of great practical utility and others of little or no importance. These instruments may be divided into four classes: *a*, those made upon the principle of the curette; *b*, the double curette or forceps; *c*, the wire loop; and, finally, *d*, the adenomatome. The first class includes the ring-knife of Dr. Meyer and its modification, and the sharpened finger-nail of the operator, a useful adjunct to the more complicated instruments; the second, the forceps of Loewenberg and its varieties; the third, a modification of the Jarvis snare; and, finally, the fourth, a double-cutting instrument, furnished with scissors blades, called the adenomatome. Of these instru-

ments, the ones most generally useful in the hands of the writer are a modified Loewenberg forceps and the sharp curette. With these, assisted by the proper accessories, most cases may be satisfactorily reached.

FIG. 23.

Loewenberg's forceps.

The other instruments necessary for operating under anæsthesia are a good mouth-gag and a soft-palate retractor. The latter should be made

FIG. 24.

Loewenberg's forceps (modified by Hooper).

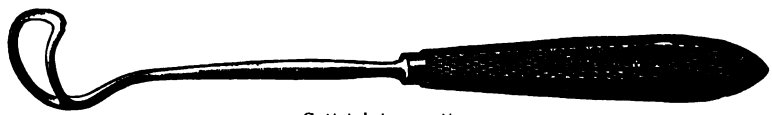
with a shank broad enough to protect the uvula from injury during the process of operation.

The position of the patient during operation is of considerable importance. Two methods are in common practice: In the first, applicable mainly to infants, the child is held upon the lap of an assistant in the sitting posture, with the head upright and turned toward a good light. The head is steadied by a second assistant, who also manages the mouth-gag and administers the anæsthetic. The soft palate may be drawn upward and forward by means of the palate-retractor, or it may be secured by tapes passed inward through the nose and outward through the mouth, the ends being tied outside after Wales's method. With the head inclined forward in this position the blood caused by the operation will tend to escape from the mouth, instead of being swallowed. Moreover, the pharynx can be well illuminated and the steps of the operation better directed by the aid of vision. The position upon the back is preferred by many good operators, requiring as it does the services of but one assistant, and being the one to which a large majority of surgeons are better accustomed. It is not so favorable as regards the admission of light to the pharynx, and therefore it requires a greater degree of skill on the part of the operator, whose tactile sense must be highly educated by way of substitute. The blood, instead of flowing from the mouth, is swallowed into the stomach. This is not a disadvantage, for it trickles down from the posterior wall of the pharynx and escapes into the œsophagus almost without making its presence felt, unless the flow excited has been considerable.

A possible objection to the upright position is the additional risk of

fragments of detached tissue falling into the larynx and thus causing asphyxia. Such accidents have been reported, having occurred in the

FIG. 25.



Gottstein's curette.

course of the use of the Gottstein curette. This would not be possible under the use of the forceps.

The management of the palate-retractor should be entrusted to a skilled assistant, as upon this the convenience, and to some extent the success, of the operation will depend. Great care should be taken to place the retractor in such a position that the antero-posterior diameter of the entrance to the upper pharynx be made as wide as possible, and that the most perfect protection be afforded to the uvula. Preliminary to operation rhinoscopic examination should have been made, and the situation, form, size, and texture of the growth well studied. Where this is impossible examination by means of the finger is admissible, and digital exploration of the pharynx should always be made after the child has been anæsthetized and immediately prior to the operation. Should the growth be large and its attachments not easily demonstrated by the finger, a curved probe will lend useful aid in determining. By the practice of careful preliminary examination a fair idea of the amount of tissue to be removed may be gained, and if, during the operation, the fragments removed be preserved, it will be easy to estimate what part of the growth has been withdrawn and how much of it still remains.

The removal of adenoid tissue from the pharynx is attended with more or less bleeding, and this, while generally of no importance, may sometimes be considerable. It is best, therefore, that the tissue be torn away rather than cut. This method has the additional advantage of greater thoroughness, as masses of adenoid much larger than the fragment grasped by the instrument are frequently separated, and by this method it is not likely that the healthy and more resisting parts will be injured. Remnants of adenoid tissue left behind by the forceps may be removed by the finger-nail of the operator, by Hooper's modification of the Loewenberg forceps, or by means of a small carefully-guided curette. Should the removal of a mass of adenoid be followed by undue bleeding, it is well to defer further attempts at operation for a few moments until the hemorrhage shall have ceased, or, at least, until it shall have sufficiently diminished. Too great force in the separation of a fragment of tissue must be avoided. It is better to release the mass included in the grasp of the forceps and seize a smaller portion, or else, by applying them in a somewhat different position to separate adherent fragments, than it is to attempt to accomplish too much at once. In cases where the growth is of considerable size it is often possible to detach it almost *en masse* by first separating it from before backward by means of a sharp spoon, and then attacking it posteriorly with the Loewenberg forceps. As large masses of hypertrophied tissue often exist upon the posterior wall of the pharynx as well as upon the vault, it is necessary to secure the removal

of these with the rest. The corners of the upper pharynx also, immediately above the Eustachian prominences, must be carefully cleared.

The manipulation of the instruments used in this operation, as well as the skilled touch necessary to the clear understanding of what is being done, are accomplishments which of course are best gained by practice and experience.

In operating upon the upper pharynx anæsthesia is of the greatest possible value both to the physician and to the patient. The almost universal testimony, both from children and adults, is to the effect that the process of the removal of adenoid tissue from the pharyngeal vault is exceedingly painful even under cocaine anæsthesia. Exceptions to this are undoubtedly met with in the case of the strong and phlegmatic and where the growth is soft. As a rule, however, patients who suffer from adenoid hypertrophy are apt to be delicate, nervous, and timorous, easily alarmed, susceptible of acute suffering, and, finally, likely to undergo a highly undesirable degree of depression as the direct result of operation. The convenience of the operator is greatly increased through the use of anæsthesia, as may be readily proved by contrasting the difficulties in the way of successfully executing a delicate operation, requiring accuracy and care, upon a struggling child with the same performance accomplished quietly and with deliberation. With general anæsthesia ample time is afforded for careful examination both before the commencement of the operation and during its progress, and for the checking of undue bleeding should any occur; perfect control of the operation, as well as of the patient, can be maintained; thorough relaxation of the throat can be secured; the inducement of retching from pharyngeal irritation, that most active and persistent of reflexes, can be avoided; troublesome remnants of the growth can be recognized and removed; undue excitement can be prevented; and finally, the whole work can be accomplished without the knowledge on the part of the patient of what has been done.

As to the choice of anæsthetics, ether, skilfully administered, has not yet been excelled.

The care of the child after the operation is a matter of importance. Two varieties of treatment—one immediate, the other remote—must be carried out. During the first thirty-six hours the patient should, if possible, be put to bed, and kept there until any abnormality of pulse and temperature has subsided and until any signs of nervous shock may have disappeared. The administration of tonic doses of iron and quinine will materially hasten recovery. Following operation, the general condition should be made as perfect as possible, change of air often being beneficial, and the patient should be carefully examined in order to determine whether or not the operation has resulted in a thorough and complete success. Should the contrary prove to be the case, further treatment may be called for, and although, when properly performed at first, it will seldom be necessary to repeat the operation, there is no reason why this should not be done when required. Indeed, it is well in difficult cases to mention to the parents beforehand the existence of such a possibility, especially in dealing with very young patients.

The pharynx being freed from the offending tissue, such conditions as catarrhal inflammation, relaxation of the uvula, and the general tend-

ency to local congestion can be greatly benefited by topical treatment, although in most instances special interference will be unnecessary. Should other causes of obstruction exist, such as enlarged tonsil or obstructed conditions of the nasal cavities, these must, of course, be recognized and relieved before the child can be completely cured.

FIG. 26.

Method of bandaging the chin to prevent mouth-breathing during sleep (French).

The second variety of treatment relates to the cure of certain direct results of the naso-pharyngeal obstruction—namely, the mouth-breathing habit, the correction of defects of speech, and the development of the physical powers of the patient and, in particular, of his chest.

When free nasal respiration has been actually established every effort should be made, to overcome the mouth-breathing habit. If the jaw drop during sleep, artificial aid may be afforded by means of a bandage of mull, as shown in the illustration, although no such attempt should be made unless free nasal respiration has been assured.

NASOPHARYNGEAL FIBROMA OR POLYP.

This variety of growth, fortunately, is of rare occurrence. It originates usually about the time of puberty, tending to subside after the patient is of age, and is most common in males.

The **etiology** is unknown. The tumors are most frequently attached to the basilar process of the occipital bone and to the base of the body of the sphenoid, whence they may extend and form widespread adhesions to almost any parts of the pharynx, the nose, or its adjacent sinuses. The development of the growth is active up to the twentieth year. After this, however, it ceases to grow, and by degrees will atrophy and practically disappear. While not highly malignant in itself, the growth is exceedingly dangerous from the destruction to surrounding parts which attends its progress. From the upper pharynx it may extend downward into the median pharynx or into the nasal cavities, and, developing under the nasal bones, cause them to expand, thus imparting to the patient the deformity of the nose known as "frog-face," a characteristic condition. Its nutrition is greatly increased by the attachments it forms as it advances, so that its growth is proportionately rapid. It may send branches into the spheno-maxillary and spheno-palatine fossæ, extending sometimes even beneath the zygoma. The outer wall of the nose may be absorbed, and the antrum of Highmore, the spheno-maxillary fissure, and the orbit thus invaded. In some cases the frontal and sphenoidal sinuses may be attacked, and through these or other channels the cranial cavity reached.

The early **symptoms** are local irritation and persistent and annoying catarrh. Hemorrhage, easily excited and often very severe, is an early sign. Later, bleeding may become excessive in frequency and amount, and the checking of it very difficult. It is especially severe where the

tumor has extended downward into the median pharynx. Early the growth may simulate the rounded and dense variety of adenoid. The hemorrhages, however, should at once excite suspicion. The presence of the growth will cause impairment of hearing and sometimes severe otalgia, change in the quality of the voice, mouth-breathing, snoring, and the other symptoms of nasal occlusion. Later, pressure upon the soft palate may prevent its vibration, and thus the snoring cease, but more or less difficulty in deglutition will be experienced from the same cause. Emesis may also come on, and peculiarly marked symptoms of lassitude, fatigue, and drowsiness. The invasion of the various adjacent cavities will be accompanied with neuralgic pain, sometimes of great severity. The discharge, when the tumor has become well developed, may be muco-purulent and offensive.

Inspection shows that the surface of the tumor is smooth, even, and rounded, and numerous large vessels may appear upon it; its color varies from a pale pink to a deep, congested, reddish color. In the nasal fossa the growth appears dark red in color, dense in structure, firmly attached, and easily made to bleed. The membrana tympani are of course depressed, owing to the interference with nasal respiration.

Nasal fibromata are subject to certain metamorphoses—as, for example, serous infiltration, mucoid degeneration, calcification, and ossification. Where the surface of the growth is exposed it is liable to ulceration and suppuration.

Diagnosis is usually not difficult, excepting in the earliest stages of the disease, the denser form of adenoid hypertrophy seldom bearing any marked resemblance to fibroma, and never attaining anything like the development of the latter. The points which distinguish fibromata are —the growth is single, smooth, remarkably dense, and confined to the vault of the pharynx. Large mucous polyps, whether solid or cystic, extending into the pharynx, rare in adolescence, do not cause the serious symptoms found with fibromata.

Sarcomata also are unusual in such young subjects, and, although they may be attended with hemorrhage, are much softer in consistence.

Fibro-mucous polyp of the nasopharynx may be mistaken for fibroma, and the diagnosis between it and the latter will only be established by microscopic examination.

The **prognosis** varies with the stage of the disease, the power of resistance of the patient, and the skill employed in dealing with the case. Confined to the nasopharynx, brilliant results may be accomplished by treatment: the progress of the growth may be stopped by a natural limitation of it, and even a cure may be effected by spontaneous sloughing. Invasion of the nasal cavity and adjacent parts, on the other hand, greatly complicates the case. Removal through the natural passages may be impracticable, and its radical extirpation impossible.

Treatment.—While its base is still absolutely limited to the pharynx, operation through the natural passages is clearly and unmistakably indicated. For this purpose the écraseur, either in the form of the galvano-caustic loop or the cold snare, has been found decidedly the most practical. In the employment of the electric loop the best method is, if possible, to surround the base of the growth with the galvanic écraseur, passed either through the nose or through the mouth. The inclusion of

the growth within the loop is often difficult. One of the simplest devices to aid this is a double cannula, made separable, through which the wire may be passed. By this means much easier manipulation is possible. The curved cannula, carried behind the palate, is inferior to that used through the nose. Great care should be taken to fix the loop, aided by the finger in the pharynx, to the highest possible point. Instruments of assured strength and perfection of workmanship must be used, and the wire not too rapidly forced through the strongly-resisting tissues.

The above directions relating to the cold snare will apply as well to the incandescent loop. While there is much to recommend the cold snare in these cases, the galvano-caustic écraseur is in some respects superior. With the latter the density of the growth may be more readily overcome, resulting in the destruction of some of the remaining tissues, and the danger of hemorrhage almost entirely done away with. With the galvano-cautery loop care should be taken to employ an absolutely reliable battery, and to apply only a moderate degree of heat. The method of avulsion has sometimes proved valuable, the growth in one case having come away entirely from the base of the skull. Attempts to tear the growths away piecemeal will be likely to cause serious hemorrhage, and are absolutely contraindicated. Again, the operator must be cautioned against using too great force, since fracture of the ethmoid, with death, has followed such attempts.

Excision without preliminary operation has sometimes been practised, but the danger from hemorrhage is so great as to make it unjustifiable.

The method of ligation is of some use, as it is free from the danger of hemorrhage. It consists in passing a noose around the tumor from the nose, tightening it as much as possible, and leaving it attached until sloughing has taken place. The objections are—the fetor and suppuration attending the process of necrosis and the risk of the mass becoming detached during sleep. In using the snare, however, where, from some accident to the écraseur, it is impossible to proceed with the operation, it is justifiable to leave the snare *in sitû*, first having twisted it so as to cause it to retain its position, and by this means destroy as much of the base as possible. The whole tumor then may be removed at a subsequent operation, or, if sufficient sloughing has taken place, it may be possible to tear it away.

Escharotics and the actual cautery have been superseded by the galvano-cautery. The use of this, both in the form of the loop and for the destruction of remnants or of points of recurrence, makes it possible, in skilful hands and with proper care, to thoroughly eradicate fibromatous growths, as was long ago demonstrated by Lincoln, the record of whose successful operations forms an epoch in the treatment of this disease.

Great aid is afforded the surgeon in these manipulations by the invariable enlargement of the pharyngeal space which is present.

Voltolini has devised a method for the application of electrolysis to these tumors which is much more rapid in its action than the electrolytic means formerly employed. By it, also, more complete destruction of the growth is ensured.

Where the snare cannot be used needles must be resorted to. This process in the case of large growths is very slow and sometimes painful.

Weaker currents are to be preferred to stronger, in that they can be continued longer. The advantage of electrolysis primarily is, that it causes no bleeding. It is also very useful in some cases irremediable by other means. With regard to hemorrhage, Voltolini says that should bleeding occur in the employment of electrolysis it is a sign that something is wrong with the current.

Where the growth has advanced beyond the vault of the pharynx and removal by the natural passages is impossible, the old method of removal after a preliminary operation must be discussed. While such radical procedures have now and then succeeded, the general statement may be made that they are far inferior in safety and success to the first-mentioned method, as their unpublished records would readily prove. Three varieties of procedure have been employed—namely, operation carried on through the nose, through the mouth, or through an entrance effected by operations more or less formidable upon the superior maxillary bone.

Methods of Preliminary Operations for Removing Larger Retropharyngeal Growths.—Nélaton's Operation.—Manne, Petit, and Dieffenbach tried to reach these growths through the mouth by dividing the soft palate. Maissonneuve modified this method, leaving the uvula untouched. After tracheotomy and tamponage of the laryngeal orifice he divided the soft palate and cut the growth away with curved scissors from the base of the skull. Nélaton extended the operation by making a transverse incision across the hard palate at the level of the second bicuspid teeth, from the middle of which another incision is carried backward through the soft tissues of the hard palate and through the soft palate. The two flaps thus formed are then separated from the bone with the periosteal elevator and scissors and turned downward and outward. The exposed portion of the hard palate is then chiselled through, thus revealing the posterior parts of the nasal cavity and the upper pharynx. The flaps are united with sutures after the operation.

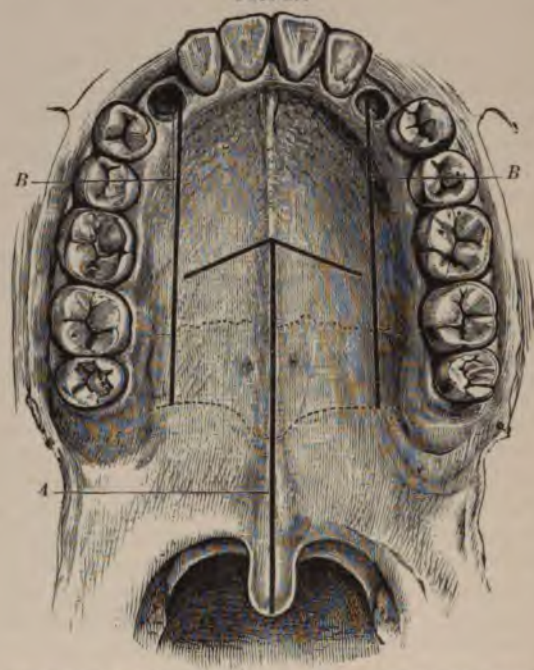
Huguier's method is really the same as that of Langenbeck, excepting that he advocates cutting through the alveolar process, and turns the lower half of the jaw temporarily aside in order to obtain greater space.

Chalot divides transversely the fold between the gum and the lip at the base of the anterior nasal spine, separates the attachment of the lip from the bone, and thus opens the nasal cavities from the front. Both upper canine teeth are removed, and, the mouth well opened with a gag, two incisions are made through the muco-periosteal covering of the hard palate, and extending, one on each side, from the site of the canine teeth to the posterior border of the hard palate, keeping close to the alveolus. The hard palate and alveolus are then divided in the line of these incisions with a chisel and mallet. The mass of bone thus included is separated from its connections with the oral and nasal mucous membrane, and is turned downward into the mouth, the line of attachment of the hard palate with the velum being used on the principle of a hinge, and admission thus gained to the upper pharynx. The tumor having been removed, the displaced bone is restored to its former position and held by a wire suture passed on each side through the alveolus.

Annandale divides the alveolar margin and palatal portions of the

upper jaw along their centre from before backward, exposes the nasal fossæ by Rouge's operation, and cuts through the septum of the nose, thus enabling the two segments of the upper jaw to be separated by a

FIG. 27.



A, Nélaton's operation for nasal polypus; *B*, Chalot's operation for nasal polypus (Treves).

space of from half an inch to an inch. Through this opening the posterior nares and base of the skull are reached.

Desprez gains access to the retropharyngeal region by dividing the connections of the cartilaginous portions of the nose on one side, so that the latter may be turned over toward the opposite side. Having first found the margin of the bony nostril, an incision is made parallel to it and to one side of the nose and a little below it. The incision is begun near the median line, and is carried down to the curve which separates the cheek from the nostril, and is made to end in the orifice of the opposite side. The ala of the nose is now separated from the maxilla by means of flat curved scissors. The nasal septum is divided at its inferior attachment as far as is needed, and the end of the nose is thus enabled to be pushed to the opposite side. As much as is necessary of the turbinated body may be removed if required. Removal of the tumor is then effected, and the nose is restored to its normal position and the incisions closed with sutures.

FIBRO-MUCOUS POLYPI.—These are composed of a mixture of the structural elements of the tissue from which they originate. They vary from a tumor of small size to one sufficient to fill the upper pharynx, and are generally smooth, dark red, and ovoid in form. They are probably more common than true fibromata.

The **symptoms** to which they give rise are principally those of nasal obstruction, although they sometimes cause catarrh and deafness. They are otherwise harmless to the surrounding structures, and are not prone to bleed. They show little tendency to recur when removed, and may be extirpated by evulsion and forceps, or, better still, by the Jarvis écraseur. The galvano-cautery loop may be employed, although it does not seem to offer any advantage over the cold wire.

ENCHONDROMA.—Enchondroma of the nasopharynx is so rare that it is practically unknown. Cases are on record, however, in which a fibrous tumor is said to have degenerated into an enchondroma.

MALIGNANT TUMORS.—Malignant tumors of the nasopharynx, although rare, are really less uncommon than has been supposed.

The **symptoms** are similar to those of fibromata, but to these are added in certain cases severe pain of a lancinating character, which is apt to be referred to the ear and to be worse at night, severe dysphagia, and general cachexia. Sarcomatous tumors may be pedunculated, while sometimes they are more or less distinctly lobulated. They present no special features to the eye or to the touch by which their true nature can be detected.

The **diagnosis** can be established by the aid of the microscope.

The **prognosis** is absolutely bad. The progress of development is rapid, recurrence after removal being almost certain, and in many cases there is a disposition toward the formation of secondary deposits in other organs.

The best plan of **treatment** consists in early recognition of the growth and its removal by the galvano-cautery. By this means it is possible that the prognosis may be modified, and that a measure of success greater than that attained by the older methods of extirpation may be reached.

Great care should be taken after removal to watch for any signs of recurrence, and, in the event of such a misfortune, to attack the disease at once.

EPITHELIOMA.—Carcinoma of the pharynx is rare. The writer has lately seen a case of epithelioma of unusual malignancy which originated in the upper part of the lateral wall of the nasopharynx and extended downward to the base of the tongue across the vault of the pharynx and down the opposite lateral wall, while forward it involved both nasal cavities. The comfort of the patient was greatly enhanced and the progress of the disease retarded by the repeated thorough removal of the soft, fungating masses which filled the upper pharynx.

DERMOID TUMORS.—The occurrence of these strange abnormalities must be decidedly rare, since in many of the best standard works they are not mentioned. The growths are undoubtedly congenital, and they must be caused by the misplacement, during an early period of fœtal life, of embryonic elements intended for the formation of structures at the opposite and external extremity of the Eustachian canal. In a case seen by the writer the patient, an intelligent adult, was unaware of the existence of the tumor for twenty years. Inspection of the pharynx revealed a pale, rounded excrescence about a fourth of an inch thick in its antero-posterior dimension, and extending downward from behind the velum palati to a point about half an inch below its free border, and

from the left lateral wall of the pharynx to the median line. It was attached to the posterior aspect of the hard palate immediately below the orifice of the left nasal fossa. Its presence seemed to have caused no particular irritation. Microscopic examination showed it to consist of a covering of true skin abundantly furnished with hair-follicles containing hairs; a delicate superficial fascia; next, a layer of fat, and under this a double plate of cartilage, covered by a true perichondrium, the whole structure being identical with that of the helix of the ear.

Chronic Hypertrophy of the Tonsils.

Chronic hypertrophy of the tonsils consists in an abnormal increase of the lymphoid tissue of the organ, sometimes accompanied with a proliferation of its fibrous stroma. The latter is apt to occur where the disease is of long standing, although not uncommon in the young.

Etiology.—The condition has been seen soon after birth, and it is often found when the child is but a few months old. Sometimes it becomes developed about the time of puberty. Predisposing causes are the same as those which influence similar conditions in other parts of the body—namely, malnutrition, the so-called lymphatic diathesis, rheumatism, tuberculosis, and syphilis. Among the exciting causes are—repeated attacks of acute inflammation from taking colds, diphtheria, scarlet fever, and, less frequently, measles and pertussis. Some cases seem to accompany recurrent attacks of quinsy. Sometimes no diathesis is apparent, and the trouble seems due to indolent catarrhal inflammation, associated with general malnutrition or with indigestion. The hypertrophic process is most active at the age of puberty, after which time it tends to decline until beyond thirty the disease is more uncommon. It may originate, however, at almost any time before adult life. It has been present in old age.

The **symptoms** are usually plain and easily recognized, and are in the main similar to those which accompany the local obstruction and irritation found with lymphoid hypertrophy at the vault of the pharynx. Respiration, circulation, and digestion are affected, causing in turn malnutrition, faulty development, and special liability to disease. Locally, speech, hearing, taste, and even olfaction, may be impaired. The nervous system may be affected, as shown by spasmodic cough and more rarely laryngeal spasm, chorea, and in a few instances epilepsy. In some cases the tonsils are chronically inflamed, without being materially enlarged, the condition giving rise to annoying symptoms. These cases may be much relieved by the application of astringents to the crypts, or, what is still better, by the opening up or cauterization of such of the latter as are either dilated or inflamed.

Treatment.—Where chronic hypertrophy has existed long, and the size of the tonsils is considerable, little benefit is likely to be gained by general treatment, and, while the effects of the latter may be tested, it is not well to temporize beyond a reasonable length of time. The indications for surgical interference will depend upon the relative size of the tonsils and upon the amount of obstruction or irritation which they are causing. An enlarged tonsil is a diseased organ, and, as a rule, enlargement sufficient to cause troublesome symptoms is of so pronounced a

character as to render the indications for treatment unquestionably clear. Removal of the tonsil has been long practised, and it has been accomplished in a great variety of ways.

TONSILLOTOMY.—Of the methods for removing the tonsil most commonly used, may be mentioned cauterization by chemical or electrical escharotics; écrasement, by means of the galvano-caustic loop or of the cold wire; abscission, by means of some modification of the knife or scissors. Both ligation and the injection into its substance of various supposed absorbents only need be mentioned to be condemned. The practice of enucleating the tonsil with the finger has lately been revived in some quarters. Excepting in young children it is of questionable value.

As escharotics chromic acid or the galvano-cautery may be used. The galvano-cautery should be reserved for a comparatively small proportion of cases, including those in which vascular anomalies may be recognized, those in which the anatomical conditions prevent a sufficiently thorough extirpation of the organ, and those in which the use of the knife is positively declined. In applying it a small-sized cautery-point is passed to the bottom of a crypt, or a fine-pointed electrode plunged into the substance of the enlarged tonsil, and the current then established. Not more than three crypts should be cauterized at one sitting. Pain is usually slight, nor is inflammatory reaction often excessive. The operation may be repeated at intervals of about a week. Cocaine will lessen the pain, while subsequent irritation may be relieved by alkaline and disinfectant sprays or gargles. This method is slow and reaction sometimes annoying.

Écrasement by means of the galvano-caustic loop is occasionally an effective and valuable method, although in simple hypertrophy, uncomplicated with malignant disease, it will be found less convenient and far more painful than other methods. In its use two precautions are necessary: the electric current should be employed intermittently, and traction should be made upon the loop only during the passage of the current. Inclusion of the greater part of the tonsil within the loop may usually be effected by dragging it inward by a forceps or by means of a transfixion needle. Local anæsthesia may sometimes be obtained by injecting into the parenchyma of the gland, before operation, five or six minims of an 8 per cent. solution of cocaine.

In rare instances, in which the tonsil is very large and fibrous and the patient is an adult, it may be desirable to use the cold-wire écraseur. The operation is tedious and in many cases very painful.

Of the methods for the removal of enlarged tonsils, none has equalled in popularity, utility, thoroughness, and, on the whole, humanity, that of tonsillotomy. Time and widespread application have proved its value. While a few still favor older methods of operating, the best authorities favor the use of the tonsillotome.

In the Physick tonsillotome, commonly known as Mackenzie's, a high degree of simplicity and perfection has been attained. Instruments of the Fahnestock class are also useful.

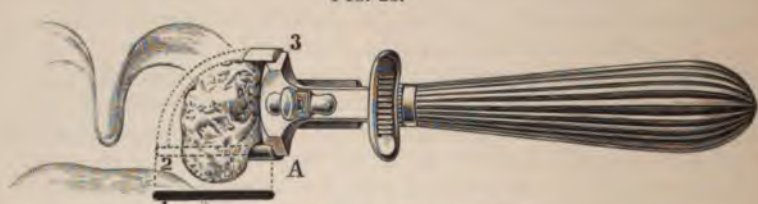
For the convenient and successful performance of tonsillotomy the aid of a trained assistant is almost indispensable. With adults and with children old enough to be under good self-control he will be of use in steadying the patient's head and in supporting the tonsils, while with

young children the possibility of operating at all will sometimes depend upon the manner in which the patient is held.

During the operation the patient should sit facing a good light, the operator with his back to it. By those familiar with the use of the head-mirror the latter, however, will generally be preferred. The patient, if an adult, should sit upright and well back in the chair, the head fixed against a properly-adjusted head-rest or supported by an assistant. The latter should stand directly behind the chair, and, while holding the head with both hands, should place the fingers of each hand over the tonsillar region of the corresponding side—that is, immediately below the angle of the jaw. Thus the tonsils may be prevented from receding before the pressure of the tonsillotome when it is introduced, and the operation may be performed with great accuracy and, if necessary, with greater thoroughness.

In the case of a child the patient is seated across one of the thighs of an assistant, who is placed opposite to the operator, the child facing inward, so that the legs of the latter may be grasped and firmly held between the thighs of the assistant. The body of the child is partly turned, so that he faces the operator, and his head is rested against the breast or the shoulder of the assistant, who controls the arms and body of the child by throwing one of his arms across the patient's chest, while with the other hand he steadies the child's head firmly against his own body. The use of a mouth-gag is unnecessary. The blade of the tonsillotome is now drawn backward and the instrument introduced flatwise and in the median line, as if it were a tongue-depressor, as far back as the pharynx. It is then rotated and applied as shown in Fig. 28. In

FIG. 28.



Method of applying tonsillotome (Hovell).

carrying the tonsillotome outward from the median line the tendency is for the angle of the mouth to be used as a fulcrum against which the middle of the instrument rests, and while the handle is carried outward the other end is drawn in the opposite direction, or inward, and away from the tonsil. The result is that, instead of squarely grasping the gland at as deep a position behind it as before, the end of the tonsillotome slips over the back of the tonsil, and the operation results in simply slicing off a section from its top. To avoid this, keep the blade of the instrument as far as possible parallel with the median line. Having engaged the tonsil in the ring of the instrument, push the blade firmly and steadily through the included tissue, separate the fragment of tonsil, and, withdrawing the instrument quickly, remove the excised gland adhering to it, and quickly and before the patient realizes that there is a second operation, before bleeding sets in, and without giving opportunity

to cough or clear the throat, excise the remaining gland. Thus both may be removed at one sitting, so that but one convalescence is to be endured: few young patients will submit to a repetition of the operation. The Physick tonsillotome has been modified, so that the handle may be reversed, enabling it to be used first in one hand and then in the other. Ambidexterity in the use of the one instrument is far better. The operation may generally be done very quickly.

As a rule, anæsthetics are not indicated in tonsillotomy. Cocaine anæsthesia is often effective, although, if the child is highly sensitive, irritable, or feeble, chloroform or nitrous oxide may be desirable. The introduction of the instrument into the pharynx is often more complained of than the actual separation of the tonsil.

Bleeding after operation is usually slight, and soon ceases spontaneously; if not, it may generally be checked by simple means, such as direct application to the cut surfaces of a mixture of one part gallic and three parts tannic acid, slightly reduced with water and applied upon a pledget of cotton. The sucking of cracked ice is also effective. Sometimes, however, hemorrhage may be severe, and, while fatal results have very rarely occurred, there are several cases on record in which this accident has taken place. With regard to this question, it may be said that moderate hemorrhage requiring direct pressure or astringents to check it is not very unusual: a severe hemorrhage occasionally occurs, and in view of the enormous number of tonsillotomies done the proportion of serious results has been exceedingly small. The source of the bleeding may be either arterial, from the division of one or two comparatively large arterial branches, or from the division of a large number of small arterial twigs; venous, from the division of the small plexus of veins which lie outside and below the tonsil; and capillary or general, from the presence of the hemorrhagic diathesis. The records show that hemorrhage has very rarely occurred before the eighteenth year. This may be explained by the presence of the larger amounts of fibrous tissue in the adult tonsil.

Should bleeding take place, careful examination, effected by the aid of strong light, should be made for the bleeding points, the surface of the pharynx having been thoroughly cleaned with pledgets of absorbent cotton. Arterial hemorrhage is recognized here, as elsewhere, by the bright color of the blood and the spurting points. Where two or three arterial twigs have been divided, these may be secured either by torsion with the long slender forceps or checked by applications of the galvano-cautery or nitrate of silver fused upon the end of a probe carefully applied to the bleeding points. Where the latter are multiple, as sometimes happens, and where pressure, ice, and styptics have failed, the best practical method is to transfix the bleeding part parallel to its surface with a tenaculum, which should be twisted and the handle held between the patient's teeth, the jaws of the latter being supported by a bandage. This position is not uncomfortable, and is maintained for any necessary length of time. In venous hemorrhage pressure and the application of cold will usually suffice, and in capillary hemorrhage the tenaculum may be used as above described. Where a fragment of sufficient size to be surrounded by a loop has been left, it may be thus included and compressed, and the hemorrhage stopped. Attempts to ligate the wound after the removal

of the tonsil have not met with favor. In addition to the above, pressure both against the wound and upon the communicating arteries of the neck, the application of the cautery, and constriction of the patient's limbs have been recommended. The cautery has been eminently unsuccessful. To quiet the general circulation and allay excitement an opiate may be administered with good effect. In severe cases, however, all known methods may fail, and the bleeding only stop upon the occurrence of syncope. It is rarely known to recommence after the latter has taken place. Faintness should be encouraged rather than avoided.

In dangerous hemorrhage from this source the question of ligation of the main vessels is one which has not been satisfactorily answered. Tying of the common carotid has failed to check the bleeding, and, while it would be supposed that ligation of the external carotid close to the parent trunk would be effective, even this measure has in the case of analogous conditions in other parts of its distribution been ineffective. Cases are not wanting, however, in which both operations have succeeded.

Secondary hemorrhage may come on a week after operation; annoying bleeding may also occur from the accidental wounding of the anterior pillar of the velum. To avoid this, any adhesions between it and the tonsil should be separated before the latter is excised.

The After-treatment.—After operation the patient's head should be kept upright, movements of the throat in coughing, expectorating, or crying should be prevented, and the surface of the wound left as undisturbed as possible. Cold milk may be given for the first twenty-four hours, and until healing has fairly been established the food should be unirritating. A simple mouth-wash of boric acid may be prescribed and the general condition properly attended to. It is well to consider these patients as suffering immediately after tonsillotomy a condition about equivalent to an attack of pharyngitis, and to care for them accordingly. The objections to tonsillotomy, as formerly made, are untenable, and, as a rule, absolutely contrary to facts.

Foreign Bodies in the Tonsil.

Foreign bodies may develop spontaneously in the tonsillar crypts through retention of the secretions of the latter. The presence of such a cheesy mass may give rise to much irritation. The condition should be relieved by removal of the deposit and free opening of the crypt. In rare instances a true calculus of the tonsil has been found. The accretions are composed principally of phosphate and carbonate of lime, and hence are not necessarily of gouty origin. Their presence may pass unnoticed, not only by the patient, but by the physician, the symptoms often being obscure. The presence of a tonsillar calculus may be determined by the discharge of fragments of the calculus, by inspection, a part of the mass being visible, or by examination with the finger or probe. Their removal may be accomplished either by enlarging the mouth of the crypt and extracting them or by excision of the tonsil.

Acute Tonsillitis.

This condition may be defined as an acute inflammation of the surface of the tonsil or of the parts beneath, or of both. It may or may not be

associated with acute pharyngitis. Clinically, it may be represented by three general varieties—the superficial or catarrhal, the lacunar or follicular, and the tonsillar and peritonsillar abscess.

The causes of tonsillitis are as varied as the forms which the disease may take; thus, the latter may be constitutional, specific, or infectious. Suppuration may follow any of these varieties, although it is probable that in the case of peritonsillar abscess the real etiological factor has little to do with the tonsil itself.

The latter disease, generally known as quinsy, is more common in young people than in infants and those past middle life. The writer has seen it in an infant six months old. Some seem especially predisposed to it, and suffer frequent recurrent attacks. A wet, changeable climate, ill-health, the rheumatic diathesis, severe mental depression or anxiety, all predispose to it.

The symptoms of tonsillitis in general are a localization of the pain in the neighborhood of the tonsil, chilliness, fever, dryness of the throat, pains in the limbs and back; the throat soon becomes painful, the tongue furred, and later in the attack the neighboring muscles are stiffened. As the disease goes on, the particular form of tonsillitis which is being developed declares itself, and the correct diagnosis of the case may be arrived at either from inspection or by a bacteriological examination of the exudate. Where the case is one of peritonsillar abscess, pure and simple, the character of the attack will generally be determined comparatively early. As this form of the disease is interesting from a surgical point of view, it will be here considered.

It should be understood at the outset that suppuration in this disease takes place not in the tonsil itself, but in the cellular tissue outside and around it. It may be divided into three varieties: First, where it forms in front and above the tonsil and points in the soft palate a little above and outside of the upper margin of the tonsil; secondly, that in which pus forms outside the tonsil and finds exit by making its way through a crypt of the latter; and, thirdly, where the abscess extends below and outside the tonsil, burrowing downward and opening through the wall of the pharynx below the tonsil. The second variety is by far the most common. It will be seen that the indications for the surgical treatment of the three varieties will be decidedly different.

The early symptoms of quinsy differ from those of ordinary tonsillitis in that from the very first of the attack there is generally present, situated just outside of the tonsil, a characteristic sensation, first, of tenderness, but quickly developing into one of deeply-seated, throbbing pain. This may precede considerably the febrile symptoms, but the latter may be attended by them. The progress of the inflammation in the throat is marked by swelling of the tonsils and neighboring structures, and often by marked infiltration in the muscular and other tissues of the neck. The latter soon causes more or less fixation of the jaws, and thus adds much to the general discomfort. The tongue soon becomes coated, and the pharynx is covered with a viscid secretion which of itself increases the local irritation and disability of the parts. Aphonia may be absent, but the quality of the voice is peculiar and distinctive. Deglutition is painful, difficult, and sometimes impossible. Constipation is generally present. The attack is usually unilateral,

although not infrequently recurrence may take place upon the opposite side of the throat.

Diagnosis is generally easy from the local appearances, the history of previous similar attacks, and the absence of the characteristic signs of other possible conditions. Demonstration of the presence of pus, however, is sometimes difficult, even bimanual palpation failing in some obscure cases to discover it. The latter painful manipulation should be used, if at all, with great care.

Prognosis.—The prognosis is generally good, although a fatal result has now and then been reported from asphyxiation of the patient by the sudden rupture of a large abscess, as well as from erosion and rupture of a large vessel. These accidents are rare. Tonsillitis will often recur, several attacks of quinsy following each other in quick succession. Taken early in hand, the duration and violence of the attack may be greatly restricted. Neglected, it may continue for several weeks. As a rule, it is promptly relieved by evacuation of the abscess.

Treatment.—Efforts to abort a genuine attack of quinsy usually fail. Attempts may be made, however, either through the use of aconite or of aconite and belladonna in frequent fractional doses, or, if the case be rheumatic, by the administration of salicylate of sodium, guiacum, or salol. Locally, cold may be applied internally and to the neck. Nutritious diet must be given, general tonics administered, and the bowels kept open, preferably by mild salines. The principle upon which the local treatment should depend consists in subduing inflammation and in keeping the throat in general, and the tonsils and lateral walls of the pharynx in particular, as thoroughly cleansed as possible. For the first, cold applications in the shape of cracked ice should be followed a little later by warmth, the latter in the form of steaming inhalations or of a weak solution of bicarbonate of soda, taken hot, and simply held far back in the throat. Gargling is not advised. In addition, a good antiseptic spray should be applied to the nasal cavities, and the pharynx cleared by causing the fluid from the spray to pass from above into the throat, when it may be expectorated. By this means, and by cleansing the crypts and folds of the tonsils with the spray, much good may be accomplished. A warm poultice to the neck may be applied when the disease has fairly progressed. The presence of pus must be recognized as early as possible, and the abscess evacuated. To do this may be difficult if not impossible. Upon the situation of the abscess will depend the direction in which it will point, as has been described already. In treating the first variety, therefore, incision should be made through the soft palate, just outside of and parallel to the anterior pillar, and in the neighborhood of the line of the upper margin of the tonsil. The incision is simply through the superficial tissues, and should be from a quarter to half an inch in length, and it should be made as early as the sensation, by palpation, of bogginess or of fluctuation indicates formation of pus. Failure to reach the abscess-cavity at once is not uncommon, the pus, however, finding its way through the artificial opening within a few hours.

In cases of the second variety evacuation may be aided by incisions into the tonsil, made as near as possible to the track of the pus. In the third class of cases the location of the abscess is most difficult to reach and its possibilities of danger the most serious. As its position may not be

demonstrable either by inspection or palpation, and the situation is such that serious swelling of the pharynx and larynx may be occasioned, or migration of the pus take place into the lower regions of the neck, such a case should be watched and treated with great care, necessary precautionary measures taken, and, if called for by the gravity of the situation, the propriety of an external incision considered.

Tumors of the Tonsils.

Tumors of the tonsil requiring radical operation are usually malignant, and are either epitheliomatous or sarcomatous. The latter are generally of the round-celled variety. The rapidity of their growth, their tendency to recur, the readiness with which the neighboring lymphatic glands become infiltrated, and, finally, the important anatomical position of the tonsil, all militate against the success of efforts made to remove them. Operation may prolong life and give a certain measure of relief, however, and in some cases at least it has effected a cure. It should never be attempted without the clearest possible understanding, not only of the normal regional anatomy of its vicinity, but, in particular, of the important arterial trunks near it and their possible anomalies. Tumors of the tonsils may be removed through the mouth or through incision in the neck and into the pharynx. The latter method is called pharyngotomy.

Operation through the Mouth.—In cases where the tumor is well defined and projecting, as in the case of some sarcomas, and, now and then, of epitheliomas which have developed in an already enlarged tonsil, removal may be successfully accomplished by means of the galvano-caustic loop or even with the cold wire écraseur, and such diseased tissue as remains subsequently taken away by any suitable method which may recommend itself. Even in this operation a preliminary tracheotomy is sometimes necessary. This method is far less dangerous, and its results are quite as good, on the whole, as the following more severe operation, the difficulties and risk of which will be apparent.

The patient having been anæsthetized, it is recommended by some that a ligature be put in position around the common carotid, so that the circulation of that vessel may be stopped, if necessary, at a moment's warning. A preliminary tracheotomy having been performed and a tampon-cannula inserted, a Mason's gag is introduced upon the side opposite to the diseased tonsil, and the mouth stretched widely open. The diseased tissue should then be cut away by means of long-handled scissors, either straight or properly curved, the growth being fixed by a long forceps or a tenaculum. If the tumor cannot be reached through the mouth, the cheek must be slit as far as necessary, in the course of which section the facial artery will be cut. The operation of removing the tumor is then proceeded with. In the case of some sarcomas the attachment of the growth is slight, so that it is only necessary to divide the mucous covering over it, when it may be enucleated without difficulty by the finger, aided by a broad periosteal elevator. When this is not possible, it must be dissected away, in the course of which procedure any diseased portion of the neighboring parts, especially of the base of the tongue or the soft palate, should be removed at the same time.

Great care should be taken to remove the affected tissue as thoroughly as possible. By the use of the cautery in such cases complete extirpation of the growth would be improbable, and considerable danger would be risked of injury to the blood-vessels or of septic infection. From the depth and obscurity of the parts a good light is indispensable. The natural light may be better controlled in some cases by the help of a forehead-reflector. The writer has employed with great satisfaction a small incandescent electric lamp, which, introduced into the deepest recesses of the pharynx, demonstrates clearly the various parts under observation, thus enabling the surgeon to distinguish between affected and healthy tissues, and to locate accurately any bleeding point. Such a lamp, of from one- to three-candle-power, should, if possible, be provided in case its use be required.

The three principal operations known as pharyngotomy for the removal, from without, of malignant tonsillar disease are Cheever's, Czerny's, and Mikulicz's.

The steps which constitute the *method of Cheever* of Boston are as follows: An incision three or four inches in length is made along the anterior border of the sterno-mastoid muscle from the level of the lobe of the ear to a point beyond the lower border of the tumor. A second incision is made at an angle to the first, along the border of the lower jaw. The flaps thus made are drawn aside, and the tumor reached by dissection of the overlying tissues. In dividing the superficial layers the external jugular vein may be cut. Free opening up of the fascia is advised, and in the course of the dissection the lower branches of the facial nerve will be met. The stylo-hyoid, stylo-glossus, stylo-pharyngeus, and, generally, the digastric muscles, will have to be cut. The facial artery and vein, which cross the region of the wound, should be ligated and divided. The submaxillary gland should be drawn forward and the parotid upward. The internal jugular and the internal carotid will be exposed, and should be drawn outward with retractors, and the dissection terminated at the pharyngeal wall, when the tumor will be reached. The latter may be removed with a scalpel or scissors, and with it the part of the pharyngeal wall to which it is attached. Enlarged glands, if present, should be recognized and thoroughly removed. Instead of making the upper incision along the ramus of the jaw, Bird has operated by slitting up the cheek, thus being able to approach the tumor from both sides.

Czerny's method requires preliminary tracheotomy and the insertion of a tampon-cannula. His incision is carried downward and outward from the angle of the mouth to the anterior border of the masseter muscle, and thence to the level of the hyoid bone. The lower jaw, having been exposed, is divided immediately in front of the last molar tooth, the saw being carried through in the direction of the corresponding incision through the skin, the divided ends of the jaw being held aside so as to give sufficient space for the subsequent dissection. In the course of the operation the buccinator, digastric, stylo-glossus, stylo-hyoid, and stylo-pharyngeus muscles must be divided, and the facial artery and vein, and probably the lingual and its vein, tied. In the course of the dissection care must be taken to avoid injuring the salivary glands and the lingual, hypoglossal, and glosso-pharyngeal nerves.

Removal of the growth is accomplished as in Cheever's method, after which the divided ends of the jaw are united by silver-wire sutures, and both the wound in the skin and that in the mucous membrane of the cheek closed, a drainage-tube having been inserted. Great care should be taken to secure absolute accuracy of adjustment of the divided ends of the jaw; otherwise, the normal adaptation of the upper teeth to the lower will be lost, and the patient thereby put to great discomfort.

By the *method of Mikulicz* a preliminary tracheotomy is required, as in the preceding method, and an incision is made from near the tip of the mastoid process to the level of the greater cornu of the hyoid bone. The soft parts are then raised from the ascending ramus of the maxilla, special care being taken of the parotid gland, facial nerve, and external carotid artery. Then the periosteum is separated from the inner and outer surfaces of the ascending ramus near the angle, where the bone is divided. The whole or a part of the ascending ramus is excised, the body of the jaw drawn forward, and the growth exposed. The muscles in relation with the outer wall of the pharynx must be divided as in Czerny's operation. The pharynx should not be opened until all of the preliminary details of the operation have been thoroughly carried out. When this is done the tumor may be removed as in the foregoing methods.

From the evident severity of the above operations it is not surprising to find that their results have not been good. Thus of 23 operations for the removal of malignant tumor of the tonsil collected by Butlin, 3 died from the operation; 3 disappeared; 10 died from rapid and 4 from somewhat later recurrence; and only 3 were alive at periods respectively of four months, one year, and two years. It is but fair to say that in a case of epithelioma in a man from whom McBurney removed the tonsil and three affected glands by a method similar to Czerny's the patient was absolutely well thirty-four months after the date of operation.

The after-treatment of these cases is similar to that employed in the more radical methods for excision of the tongue. Great care must be taken to keep the mouth absolutely clean; free drainage must be maintained, and the wound must be frequently irrigated. The patient should be fed through a tube in cases where the neck has been opened, and this process continued for several days. In the management of the external wound the head should be fixed as in treating cut-throat.

Rhinoscopy.

Posterior Rhinoscopy.—In performing posterior rhinoscopy proceed exactly as in laryngoscopy as far as the position of the patient and the light are concerned. In other words, the patient should be seated directly in front of the examiner, with his shoulders thrown somewhat forward, his chin slightly elevated, and his head in such relation to the illuminator that the light shall be a little behind and on a level with his ear. Then the light from the illuminator is caught upon the head-mirror, thrown into the patient's pharynx, and, the mirror having been rotated until the perforation is opposite the observer's eye, the focal distance is determined by advancing or receding until the position is found in which the brightest illumination is produced. Instead of the patient's tongue

being drawn forward, however, it is depressed by means of the tongue-spatula. A smaller throat-mirror is employed than is used in laryngoscopy. This is cleaned and warmed, as has already been indicated, prior to the insertion of the tongue-depressor, and introduced with the reflecting surface uppermost. Instead of carrying the mirror under the uvula, it is passed between that appendage and the soft palate. As much space as possible between the soft palate and the posterior wall of the pharynx must be secured, and for this reason the patient should breathe through the nose. As this is done the soft palate is relaxed, and the mirror may be inserted a little to one side of the median line, carried back as far as possible, and the parts above examined. In laryngoscopy the mirror, which is in contact with the soft palate, must be held perfectly still to avoid producing retching. In posterior rhinoscopy the mirror is not in contact with anything, and its position can therefore be changed. Indeed, it must be placed at a number of angles, because of the large

FIG. 29.

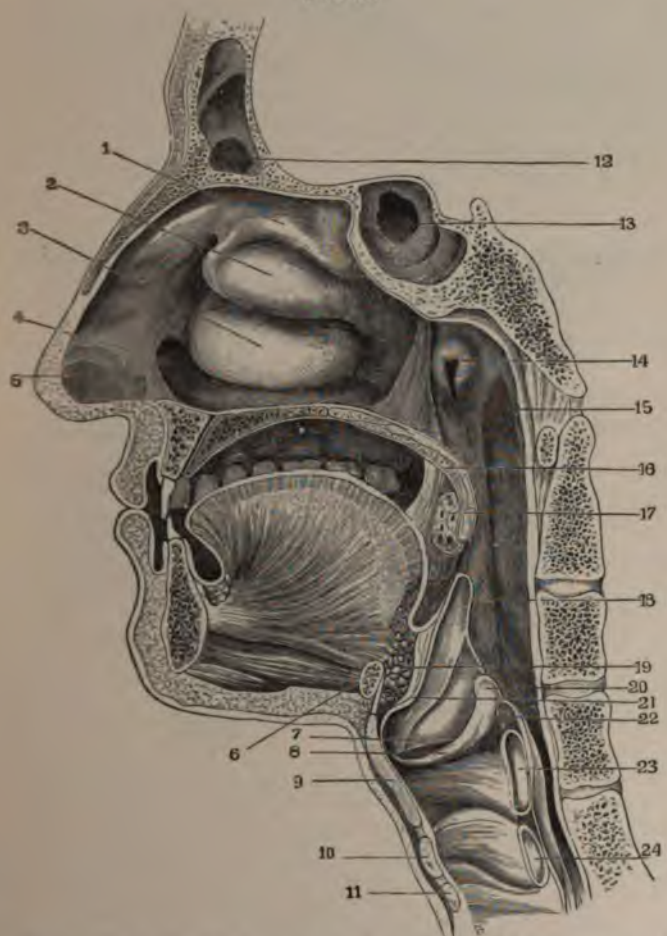
Rhinoscopic image: 1, vomer or nasal septum: 2, floors of nose; 3, superior meatus; 4, middle meatus; 5, superior turbinated bone; 6, middle turbinated bone; 7, inferior turbinated bone; 8, pharyngeal orifice of Eustachian tube; 9, upper portion of Rosenmüller's groove; 11, glandular tissue at the anterior portion of vault of pharynx; 12, posterior surface of velum (Seiler).

extent of the retronasal space. In examining the posterior nares for the first time one is likely to become confused. This can be avoided by adhering to the following rule: First, find the median line, which may be done by locating the posterior edge of the nasal septum, which is almost invariably perpendicular and sharply defined. Having found this, we know that on each side of it are the nasal cavities. By changing the position of the mirror slightly, first one nasal cavity and then the other are brought into view, together with the posterior extremities of the turbinated bodies. Having examined the posterior aspect of the nasal cavities, by changing the position of the mirror the vault of the pharynx is easily demonstrated. Then, returning again to the landmark, the posterior edge of the septum, the lateral walls of the pharynx, and the orifices of the Eustachian tubes may be found. By following this method it will soon be possible to learn to identify the parts clearly and without confusion.

ANTERIOR RHINOSCOPY.—Examination of the anterior nares, while it appears to be very simple, is, in fact, difficult, because, within normal limits, the nasal cavities vary greatly in different persons. Here we are

ng into a deep cavity, and, contrary to what is true of laryngoscopy posterior rhinoscopy, the focal distance will frequently have to be ged in order to bring all of the parts into view. In making an exation of the anterior nares great assistance is derived from (1) a

FIG. 30.



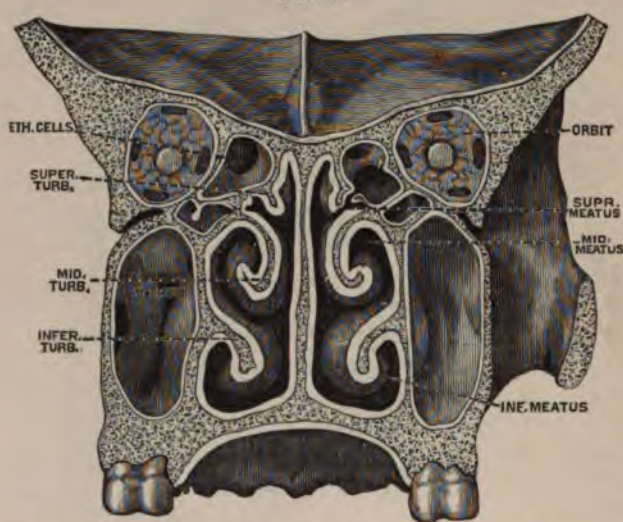
ital section of head, slightly diagrammatic: 1, superior turbinated bone; 2, middle turbiated bone; 3, lower turbinated bone; 4, floor of nasal cavity; 5, vestibule; 6, section of yroid bone; 7, ventricular band; 8, vocal cord; 9 and 23, section of thyroid cartilage; 10 and 4, section of cricoid cartilage; 11, section of first tracheal ring; 12, frontal sinus; 13, sphenoidal cells; 14, pharyngeal opening of Eustachian tube; 15, Rosenmüller's groove; 16, velum palati; 17, tonsil; 18, epiglottis; 19, adipose tissue behind tongue; 20, arytenoid cartilage; 21, tubercle of epiglottis; 22, section of arytenoid muscle (Seiler).

rough cleansing of the parts; (2) the use of the probe, by which disces can be measured and the consistence of the various parts appreted; and (3) the use of cocaine, which enables us to dilate the passes when they are contracted, thus admitting the light to parts which erwise would be invisible.

Anterior rhinoscopy is performed with the aid of a nasal speculum,

of which there are many varieties. The blades of the speculum should be introduced completely into the vestibule of the nose, but not so far as to press upon the bony ridges which separate the vestibule from the nasal cavity proper. The inner blade of the speculum should rest against the septum, and dilatation be accomplished by pushing the outer blade upward and outward, the tip of the nose being carried slightly upward and the vestibule expanded to its fullest extent. The light having been thrown into the nose through the speculum, the position of the patient's head is changed from horizontal to extension far backward and slightly from side to side, so that all of the cavity may be brought successively into view. With the patient's head inclined slightly forward the light may be thrown upon the floor of the nose through the

FIG. 31.



Transverse vertical (*i. e.* coronal) section of the nasal fossæ at the plane of the second molar teeth, seen from behind (Hirschfeld).

middle meatus and upon the anterior part of the inferior turbinated body. Throwing the patient's head slightly backward, the rest of the inferior turbinated body, the middle meatus, and part of the middle turbinated body may be demonstrated, while with the head thrown sharply backward the upper and anterior region of the nose may be brought to view. The superior turbinated body is generally not visible by anterior rhinoscopy, although easily demonstrable posteriorly.

In the examination of infants anterior rhinoscopy is performed as in the adult. For posterior rhinoscopy is substituted the method of palpation. This is performed by steadying the child's head with one hand, while the fore finger of the other, previously prepared carefully for the purpose, is gently inserted into the upper pharynx and the necessary explorations quickly made. Control of the patient's lower jaw is desirable. It is often possible to teach a child of three or four years old to submit to posterior rhinoscopy, and whenever possible this should be done.

Transillumination is employed for the purpose of ascertaining the presence of fluids or new growths in the maxillary and frontal sinuses. The patient is placed in a dark room, and for illuminating the antrum

FIG. 32.

Electric lamp for transillumination of the frontal sinus.

a small incandescent lamp is placed in the mouth, the lips closed over it, and any asymmetry of the shadows of the face noted. In demonstrating the frontal sinus the lamp is concealed within a piece of rubber tubing, the free end of which is applied to the floor of the sinus just above the inner canthus of the eye.

TUMORS AND POLYPS OF THE NASAL CAVITIES.

The form of tumor known as simple mucous polyp, naso-fibroma, or, incorrectly perhaps, nasal myxoma, is by far the most common form of neoplasm found in this region.

The **etiology** of these growths is obscure. Injury resulting in inflammation and disease of the neighboring osseous tissue, especially where suppuration is present, seems liable to favor their development.

Nasal polypi occur rather more frequently in men than in women. They are seldom met with until after the age of adolescence, although the writer has seen a case in a girl of six. They may occur earlier in girls than in boys. In most cases their duration is difficult to determine.

The **symptoms** are, in general, those of obstruction to breathing, loss of the olfactory sense, local irritation, and persistent catarrh. They are usually referred to a time at which the patient became especially susceptible to acute coryza: the symptoms have grown progressively more annoying, and they finally reach a state where they are incessant. When the polypi are located comparatively high in the nasal cavity or are confined to one side, so that nasal respiration is not perceptibly impeded, the patient may be unaware of their presence. On the other hand, the growths may be actually seen to protrude from the vestibule of the nose. As nasal obstruction becomes more pronounced the symptoms and the general discomfort become more severe. Mouth-breathing, snoring, and fatigue upon comparatively slight exertion are usually present. Reflex symptoms are not uncommon, such as headache, oftentimes severe, neuralgia in different localities and especially through the distribution of the facial nerve, reflex cough, and, finally, marked asthmatic attacks. The eye must suffer from irritation of the conjunctiva and lachrymation and from various more or less obscure disturbances of vision. It is unnecessary to say that the auditory apparatus may also be seriously affected,

owing to the obstructed nasal respiration, the catarrhal inflammation, and the possible reflex irritations which the polyps may excite. Vertigo, impairment of memory, mental hebetude, and insomnia are more or less commonly observed. The symptoms of coryza may vary from a tendency to sneezing and to the appearance of a watery discharge, apparently from slight exposure to cold, to catarrhal symptoms of the most pronounced and inveterate character and with excessive secretion. Pronunciation is affected, and the tone-quality and carrying power of the voice greatly impaired. There is peculiar inability to fix the attention in these cases, called by a recent writer *aprosexia*.

The presence of nasal polypi may be determined by anterior or by posterior rhinoscopy according to their location. Sometimes, however, they are so situated as to make their recognition difficult. This is par-

FIG. 33.

Vertical section through nasal cavity, showing nasal polypi (Seiler).

ticularly the case when they are concealed beneath the middle turbinated body. Their appearance varies somewhat. In color they are usually of a pearly-gray or pinkish-gray color, opalescent, and somewhat translucent. When subjected to irritation they may become of a pink or even a deep-red color, and the surface roughened and almost papillomatous in appearance, resembling hypertrophied mucous membrane. In all cases fine blood-vessels may be seen traversing the surface of the growths. The substance of the tumor is composed largely of fluid, and, in fact, they are distinctly hygroscopic, the patients commonly complaining of great increase of irritation both from damp weather and from the application to the nasal cavities of watery solutions.

The favorite seat of implantation of nasal polyps is the middle turbinated body and the middle meatus. They occur very commonly

attached to the superior turbinated and in the superior meatus. They are rarely found upon the inferior turbinated body. Their occurrence upon the nasal septum may be regarded as a pathological curiosity. Recent cases are apt to be sessile, those of old growth pedunculated. The number in a given case may vary from one or two up to large collections. The size of the pedicle bears no relation to the volume or development of the growth. The affection is not necessarily bilateral, although commonly so. Associated with polyps may be hypertrophies of the various soft tissues of the nose, especially of those covering the middle turbinated, and various deformities of the septum. Suppurative disease of the sinuses adjacent to the nose is apt to be associated with polyps. Polyps situated posteriorly sometimes show cystic development. The latter variety may protrude into the retronasal space, attaining very large dimensions and giving rise to much obstruction and irritation; its appearance at the same time may become greatly modified, simulating a sarcomatous growth.

The **diagnosis** of nasal polyp is usually easy, the only difficulty being to differentiate between this growth and turbinated hypertrophy, and in cases situated posteriorly between simple polyp and some more serious neoplasm. In the case of the former, as suggested by the writer some years ago, differential diagnosis may be established by the use of cocaine, under which the hypertrophic tissue will show marked contraction, while the size of the polyp will not be materially altered.

The **prognosis** is not serious. There is no evidence to prove that mucous polyp spontaneously disappears. The history is usually one of progressive aggravation of the symptoms, the discomfort finally becoming so severe as to compel relief. Under skilful and persistent treatment the growths may be completely removed and, generally, their recurrence prevented.

The **treatment** of nasal polyps should be directed primarily to their thorough removal, and, secondarily, to the prevention of their recurrence. For the former various means have been employed from an early period, some of which are still in use. Such methods as ligation, dragging through the nasal cavities a sponge attached to a cord, and injections into the growth of various chemical solutions have generally been abandoned. External applications to the growth are almost invariably ineffective, if not positively injurious, owing to their hygroscopic properties. Rarely, astringents may retard the development of the polyp and add to the comfort of the patient. The means most commonly employed, however, are those by which the growth is removed with forceps, separated by means of a wire snare, or destroyed by the galvanic cautery or ring knife. With regard to them, operations for the removal of polyps under the old methods were painful and unscientific. In order to operate intelligently and successfully the nasal cavity, under cocaine anæsthesia, should first be demonstrated by anterior rhinoscopy, the removal of as many polyps as possible effected, and, when sufficient hemorrhage has occurred to obscure the parts, further operation deferred until another sitting. Variously constructed forceps are used for this operation, and for the removal of certain varieties there is no better method. In general, alligator forceps, the jaws of which should be serrated and not too large, will be found the most convenient.

The most generally useful and least painful instrument for the removal of polyps is the Jarvis snare. For the removal of small growths situated

FIG. 34.

Jarvis snare.

high in the nasal cavity a finer quality of piano wire than No. 5—that commonly employed—is desirable.

The removal of cystic growths, whether situated anteriorly or extending into the pharynx, is often difficult from their great size. In any polyp of unusual dimensions an incision into the wall of the tumor will demonstrate its true character, and, if a cyst, cause it to collapse, when it can be removed with ease. The galvano-caustic loop for the removal of simple nasal polyp is seldom necessary. A fine ring knife is sometimes useful for the removal of growths which are difficult to reach by other means.

If difficulty be experienced in anæsthetizing the seat of the growth, it may be well first to cause contraction of the parts below, and then apply the solution through the space thus gained to the desired point. Little immediate treatment is needed after operation beyond protecting the sensitive membrane from the too free access of the air, especially in bad weather, and the keeping of the parts properly cleansed and disinfected. The necessity for antisepsis in regard to the instruments employed is emphasized by the fact that dangerous pyæmic symptoms have followed the careless removal of a simple mucous polyp.

For the prevention of recurrence the growths must not only be removed, but the localities from which they have originated must be absolutely freed from all trace of their presence. Either at the time of removal of the growth proper or at a subsequent sitting their sites must be carefully examined, and, if necessary, applications of the galvano-cautery or other caustic made to bring about the desired end. The nasal cavities should be treated locally meanwhile with alkaline and antiseptic sprays, and, if necessary, with astringent solutions, followed by insufflations of dermatol or of some of the other substitutes for iodoform, which in these cases is obviously inadmissible. Removal of fragments of bone to which polyps of a certain class seem to have been attached is sometimes desirable to secure against recurrence. It has been suggested also that the removal of the anterior extremity of the middle turbinated may be required, in order to gain access to the region which it covers for the thorough extirpation of growths which may occur within it.

McDonald suggests that there is one condition in which a polypus may not only be allowed to remain, but, if possible, its growth might be encouraged—namely, in the rare event of one appearing in the course of an atrophic rhinitis, its presence acting as a stimulus to secretion, and thus proving helpful.

ANGEIOMATA.—Angeiomatous growths are the most common of the somewhat rare varieties of neoplasm found in the nose. There are gen-

erally included under this name all growths in which the vascular element predominates, such as erectile tumors or nævi, vascular tumors, angeioma cavernosum, and the fibro-angeiomata. The tumors may be attached to the cartilaginous septum, to the upper parts of the nasal fossæ—as, for instance, the vomer, the basilar apophysis, the inferior surface of the body of the sphenoid, and the vault. The middle turbinated bodies are not often involved. The growths always occur unilaterally, and seem to prefer the left side. Age does not seem to influence them. They are more common in men than women. From the structure of the inferior turbinated bodies it would be natural to expect to find them the site of the above neoplasms. This, however, is not the case.

The **duration** is uncertain, some cases giving the history of having suffered from epistaxis since childhood, while in others a tumor of unusual proportions may develop within a few weeks.

Of the **symptoms** observed, epistaxis is by far the most common and well marked. It is present in every case, and the attacks are generally profuse and persistent.

In the **treatment** of these cases the most satisfactory method as a rule has been écrasement by means of the Jarvis cold-wire snare. As the growths vary indefinitely as to size and location, the choice of operation will have to be guided by the peculiar needs of the case in hand. Their extreme vascularity renders operation not only difficult, but dangerous, and the possibility of fatal hemorrhage should induce the observance of every precaution in treating them.

ADENOMATA.—These growths consist in an hypertrophy of the glands of the mucous membrane. They would be harmless were it not for the tendency which they display to undergo epitheliomatous degeneration. The tumor at first bears a decided resemblance to a mucous polyp. It is, however, of firmer consistence, approaching somewhat that of an enchondroma. Its progress is slow as long as degeneration has not begun. When this becomes established, however, the course is that of an ordinary epithelioma. In the period of transition the differential diagnosis can be made only by the use of the microscope. The treatment must be surgical.

EXOSTOSES.—Exostoses of the nasal fossæ, other than those mentioned under the head of bony ridges or spurs of the septum in the article on congenital and acquired malformations of the nose, are rare. The same methods of treatment would apply to them as to the cases of osteomata referred to above, at least when they are situated upon the septum.

DERMOID OR EMBRYONAL CYSTS.—Of the nature of these growths are certain abnormalities which have been observed occasionally in the nasal fossæ. They may consist partly or altogether of hair, or they may contain cartilage, bone, fat, connective tissue, and glandular substance. The presence of teeth in the nose has been observed in several instances, and seems to be the most common accident of this class, the number of such cases reported in this country and elsewhere being considerable.

OSSEOUS CYSTS.—Several cases have been reported in which this condition was present in the nasal fossæ. The cysts originate sometimes in the bony tissue itself, sometimes between the bone and the periosteum. They may be either unilocular or multilocular. They are generally

crossed by lamellæ of bone which incompletely divide them, and they are often surrounded by a bony ridge due to chronic inflammation of the periosteum. They are apt to originate upon the septum or upon the inferior turbinated bone.

Their **symptoms** are analogous to those of an osteoma, and their course slow, but progressive.

The **treatment** applicable is either the radical extirpation of the cyst or incision and destruction by the aid of the galvano-cautery. If the cyst be multilocular, each division must be opened in turn, and this treatment must be continued until the growth has disappeared. Roaldes has reported with full bibliography the successful removal of the growth in a case of compound follicular odontoma of enormous size invading the maxillary sinus and obstructing the corresponding nasal fossa.

In addition to the tumors above described, echinococcus cysts and herniæ cerebri have been met with in the nasal fossæ.

PAPILLOMA.—While veritable growths of this variety sometimes occur in the nose, they must not be confused with the so-called papillary or "mulberry" hypertrophy of the soft tissues of the turbinated bodies, as has been clearly shown by Wright.

Their **treatment** is simple, and does not call for special consideration, removal with the cold snare and cauterization of the base being generally effective in destroying them.

MALIGNANT TUMORS.—Malignant tumors of the nasal fossæ of primary origin are rare. It is possible that long-continued and unusual irritation of the nasal mucous membrane may be a factor in their production. With the exception of sarcomata, they occur more commonly after middle life. Sarcomata, however, have been found in very young children.

Sarcomas are said to arise most frequently from the septum. They might easily be mistaken for enchondromas, were the latter not distinguished by symptoms which are pathognomonic. They are apt to develop rapidly, and to extend to the various cavities in their vicinity, causing much destruction to the surrounding parts and consequent deformity.

The **symptoms** generally present are obstruction of the affected nasal cavity, followed later by epistaxis and the secretion of a sanious, fetid, muco-purulent discharge; respiration is of course impeded, the quality of the voice changed, and the olfactory sense impaired. Neuralgia is a marked and distressing symptom. It may attack one or both sides of the head, and it generally increases in severity until the nerves pressed upon by the growth are paralyzed. Upon examination the tumor, in the earlier stages, is seen to be simply red and perhaps nodulated; later it becomes ulcerated, grayish in color, and covered with an unhealthy secretion. It bleeds at the slightest touch.

Epitheliomatous tumors may be distinguished from simple myxomata by the fact that they are redder, highly vascular, and that they bleed easily. These symptoms render the diagnosis tolerably easy, while the presence of a single growth, its rapid development, the destruction which it carries to the surrounding parts, and the other well-marked symptoms of pain, discharge, epistaxis, and general cachexia will place the question beyond the possibility of a doubt.

As to the **diagnosis** of malignant growths of the nose in general, their early recognition is often exceedingly difficult. It is, at the same time, most necessary, for upon it will depend, in great measure, the prognosis. Although it has been stated that the septum is their common site, this, in the experience of the writer, has not been the case, nor does there seem any reason, histologically, why it should be so, since the other structures of the nasal fossæ are more vascular and probably subject to greater irritations. Great rapidity of growth, especially of the tumor which has returned after removal, is characteristic of sarcoma. Early microscopic examination of a part of the growth is of course very desirable.

The **prognosis** is grave. Growths of the sarcomatous variety seem to be of a less malignant nature than the others, and with them the prognosis is not absolutely bad. Morell Mackenzie reports a case in which a myeloid sarcoma was removed from the nasal septum in a man aged sixty, in whom seven years after the operation there were no signs of recurrence. In a case of melanotic sarcoma removed by Lincoln from the middle turbinated body and outer wall of the right nasal fossa of a lady of thirty the patient was well when last heard of, three years after operation.

The older authorities agree that the only proper method for the **treatment** of malignant growths of the nose is thorough and radical extirpation, and they generally recommend that, in order to render the operation a success, the growth be fully presented to the vision of the operator by means of a preliminary operation. This, however, with the improved methods and instruments at present used is by no means necessary in a large number of cases. In the case of melano-sarcoma quoted above the operation was performed through the natural passages by means of the galvano-cautery, and with absolutely no mutilation of the external parts. The use of the electric needle or of electrolysis may be effective. In a case of ordinary sarcoma observed by the writer decided arrest of the growth seemed to follow injections into its tissue of lactic acid, twenty minims of a 30 per cent. solution being used. Another palliative measure is the persistent application to the surface of the tumor of an astringent solution, while attacks of hemorrhage may generally be controlled by the use of the galvano-cautery.

While it would be premature to recommend treatment by injections of the toxines of erysipelas, it is to be hoped that sooner or later, by this or some other analogous non-operative form of treatment, these unfortunate cases may be relieved.

Nasal Duct.

The nasal duct, considered in relation with diseases of the nose, is often the seat of catarrhal inflammation coincident with similar conditions in the nasal cavities. Another source of irritation to it, and sometimes of actual occlusion, is swelling or hypertrophic thickening of the mucous membrane in the region of its nasal orifice. The occurrence of stubborn chronic conjunctivitis in connection with nasal catarrh, the former only being capable of relief when the latter condition is remedied, is very common, and suggests an important pathological relation between the nasal duct and the parts which it connects.

Insects and Foreign Bodies in the Nose.

The impaction of a foreign body in the nose is an accident of common occurrence. The entrance of living organisms, on the other hand, is somewhat rare in temperate latitudes, but sufficiently common in tropical and subtropical countries. While the former seldom gives rise to severe symptoms, the latter may readily prove fatal.

Foreign bodies are of course most likely to be found in that part of the canal possessing the greatest diameter. Hence the inferior meatus is their most common place of lodgement. Any object sufficiently small and capable of locomotion, such as an insect, may find its way into one of the adjacent sinuses. The mucous membrane which lines the nose is particularly delicate in its construction and acute in its sensibility. It is also highly vascular, and capable of an extraordinary degree of distention. A foreign body may therefore give rise to great irritation, as may also attempts made to extract it.

The variety of foreign bodies which have been found in the nose is very great. The list comprises extraneous substances introduced either by accident or design by infants or insane adults; sequestra of diseased bone; and parasites.

The **history** is usually as follows: A child of about two years of age thrusts some small rounded object into its nostril. If the act should be unobserved by the child's attendant, the body may escape immediate detection. Soon symptoms of chronic inflammation are established. These are confined to the nostril in which the body is, and continue until it is removed, the irritation often being severe and the discharge extremely fetid. The mucous membrane adjacent to the foreign body is in a condition of superficial erosion; the body, if too firmly impacted to be dislodged by simply blowing the nose, remains fixed until removed by the surgeon. Not infrequently the presence of a foreign body passes unsuspected and the child is treated indefinitely for simple catarrh. A body impacted in the nose has been carried for periods varying from nine to twenty-eight years, although in every instance the patients had been under medical treatment.

Treatment.—Preparatory to removing a foreign body first cleanse the mucous membrane anterior to it. Then thoroughly anæsthetize the membrane with a solution of cocaine of from 6 to 10 per cent., repeating the application, if necessary, after the lapse of about five minutes. The engorged and thickened tissue will quickly retract, and, the passage thus having been widened, the body may often be extruded by simply blowing the nose. Should it still be so firmly impacted as to require the use of an instrument, its removal will be greatly facilitated by the anæsthesia of the parts as well as by the additional space provided. A probe or small forceps will often answer the purpose of extraction. If necessary, the body may be first crushed. The copious hemorrhage which commonly results from the old method of extraction is not likely to follow after the use of cocaine, for the reason that less injury is done to the parts.

In all cases of fetid catarrh, particularly when confined to one side and dating back to infancy, careful examination with speculum and probe should be made, the nostril having first been thoroughly cleansed by

means of a warm douche and the presence of a foreign body excluded before a positive diagnosis is made.

Diagnosis.—As a rule, this may be done without difficulty. In some cases, especially those of long standing, the foreign body may be completely covered with and concealed by the secretions of the nose, or, as more often happens, it may be surrounded by a mass of granulations which mask its identity. In the latter case the appearances may suggest syphilis, malignant disease, or lupus, and have often been mistaken for them to the distress and detriment of the patient. The sensation imparted to the probe as the latter impinges upon the hard surface of the body will at once determine the nature of the trouble.

After removal of the object the nostril should be washed several times a day with a weak disinfectant, preferably a solution of permanganate of potassium. Cure of all of the symptoms quickly follows.

Foreign bodies or inspissated mucus sometimes becomes the nucleus of the so-called rhinoliths, or nasal calculi, concretions formed by an accumulation of the earthy salts of the nasal secretions, chiefly carbonate and phosphate of lime. Sequestra of bone, particularly in tertiary syphilis, sometimes remain in the nasal cavity after their separation, thus acting as foreign bodies.

Foreign bodies of extraordinary size—such, for instance, as the breech-pin of a gun—have been forced into the nasal cavity from without, and have only been discovered post-mortem after the lapse of several months.

Fungi and Parasites.—The oïdium albicans is occasionally, though rarely, met with in the nose, while John Mackenzie and others have reported cases of the aspergillus found in the same region. Ascarides have been met with, and leeches, centipedes, and earwigs have found their way into the nasal cavities. The symptoms commonly present after such an accident are epistaxis, sneezing, headache, lachrymation, nasal discharge, and stenosis.

In the tropics, seldom elsewhere, various kinds of flies, most commonly of the variety known as *Lucilia hominivora*, may enter the nasal chambers, preferably of a patient suffering from catarrh, and there deposit their eggs. This condition in India is known as "peenash." Cases are occasionally reported from our Southern States and from Mexico, while even as far north as Massachusetts and Illinois it has been known to occur. The history is usually as follows: While the individual is sleeping in the open air a fly enters his nose, and, penetrating to a greater or less depth, sometimes even into the frontal or the maxillary sinus, there deposits numerous eggs. These, by the warmth and moisture of their surroundings, are quickly hatched, causing in succession irritability, tickling, and sneezing; later, formication, bloody discharges, and epistaxis, with redness of the face, eyelids, and palate; excruciating pain, generally frontal, insomnia, and, if the condition continue unrelieved, necrosis of the parts, convulsions, coma, and death. Sometimes the larvæ are sneezed out, or they may be seen on examination of the nose, which of course will establish the diagnosis. The destruction caused by them may extend to the mucous membrane, the cartilages, and even to the bones of the head, the ethmoid, sphenoid, and palate bones having

been found carious. The extension of the destructive processes is often very rapid.

It is evident that the true condition of affairs should be recognized at once, and that treatment should be pursued with the greatest possible promptitude and efficiency. What this should be must be difficult, in the more serious cases, to determine, and should be selected somewhat with reference to the stage of development of the larvæ and the progress which the condition has attained; for when the former first appear they are located upon the surface of the mucous membrane, probably in more accessible positions than they will occupy later on. Moreover, in the course of a short time the larva buries itself in the substance of the membrane so deeply as to make it almost impossible to extract it, even with the aid of forceps. If the case can be seen before the larvæ have migrated into the deeper regions or before they have buried themselves too deeply into the tissue, it is possible to cause their immediate and thorough expulsion. For this purpose the parts should first be well cleansed, following which anæsthesia and complete retraction of the membrane should be secured by applications of cocaine. When the above has been accomplished, inhalations of chloroform or of ether may be employed, the effect of these drugs being to cause the insects to voluntarily vacate the nose in search of fresh air. Injections into the nose of dilute solutions of the same remedies have been recommended, but must be extremely irritating. Insufflations of calomel, of infusion of tobacco, of turpentine, and of alcohol have been recommended. Of these, the two former seem to have given the best results. As failure to relieve the patient is sure to be followed by death, the propriety of surgical operation in extreme cases is worthy of consideration.

Rhinoscleroma.

This rare condition, first described by Hebra, is a disease involving both the integument and the mucous membrane of the nose. It is rarely found outside of Eastern Russia and the neighboring countries and in some parts of Central America.

The disease appears in the form of flat, or rather elevated, sharply-defined, isolated or conglomerated tubercles, rounded prominences, or flat structures of considerable density, which occur upon the skin or mucous membrane of the alæ nasi and the adjacent parts of the lip. In a case seen by the writer the tubercles were the color of the adjacent skin, shiny upon the surface, devoid of hair, and traversed by dilated blood-vessels. Sometimes the color is of a brownish red. At the attachment of the alæ there may be fissures which discharge a scanty exudation from which scabs are formed. Sometimes the patches are exceedingly hard, and tender to touch. They are more or less symmetrically developed on both sides. The growth may increase to such an extent that the alæ may become very much enlarged and occluded, while the tip of the nose is broadened and depressed. A marked rigidity of the affected parts becomes apparent in consequence of the infiltration, which in time extends to the mucous surface of the lip and spreads to the alveolar portion. Its extension may be indefinite. In the later stages of the disease it may progress backward, attacking the soft palate, which becomes united with

the posterior wall or to the larynx, which becomes so infiltrated and thickened that tracheotomy may be required to relieve the resulting stenosis. Rarely the tongue, eyes, and ears are attacked. Much pain may be suffered when the disease has reached the mouth and the pharynx. Occasionally ulceration is seen in the pharynx, but usually it is not of a very severe character, and sometimes shows a ready disposition to cicatrize.

Pathologically, the growth seems to resemble round-celled sarcoma, although differing from it by the presence of certain small hyaline bodies of highly refracting power which seem to form its characteristic element. The latest investigations seem to demonstrate that certain microbes are an evident factor in its propagation. The fact that it is infectious has been proved by successful inoculation of cultures of these micro-organisms.

The disease must be differentiated from syphilis, epithelioma, and keloid—from syphilis by the failure of constitutional treatment and by the persistence of the nodules, which in syphilis sooner or later either undergo suppuration or resolution. Epithelioma could only be mistaken before the appearance of ulceration, and even then there should be little difficulty in appreciating the difference. From keloid the diagnosis would be impossible, were it not that microscopically the latter is composed entirely of fibrous tissue.

Treatment.—So far as is known, the only efficient treatment is excision.

Epistaxis.

Epistaxis, or hemorrhage from the nasal cavities proper and their accessory sinuses, may be either active or passive. It may result from violence, it may point to the existence of some remote pathological condition, or it may occur as a vicarious phenomenon. The former is the most common. Traumatic epistaxis may follow any surgical injury of the nose or result from mechanical irritation of the membrane covering its interior, such, for instance, as irritation from the finger-nail, operations performed in the nose, or the application of irritating substances to it or to the nasal pharynx. It may also occur from rupture of varicose veins in the pharynx or distention of the capillaries due to organic diseases of the heart; from severe exercise; from the inhalation of irritating vapors and powders, or from toxic doses of certain drugs eliminated through the mucous surface of the upper air-passages; from injury caused by ulceration of any kind, the removal of adherent crusts or foreign bodies, or organisms, such as insects, in the nasal cavities and adjacent sinuses; and from the presence of tumors of various kinds. It is also present in fracture of the skull, especially at the base, and is also found with necrosis or caries of its bony skeleton. It has been caused among gunners by the severe concussion of heavy ordnance.

Epistaxis from trifling causes may exist from individual idiosyncrasy, from a general tendency to bleeding, and from disturbances in general of the vascular system, and organic diseases of the heart, kidneys, lungs, and the pleura. In the latter it is met with as the result of passive venous hyperæmia. It may also be due to interference with the circulation of the neck, pharynx, and abdomen, and in certain congestive

conditions of the cerebral circulation. The sudden transition from a normal into a rarefied atmosphere may occasion it. It is not infrequently the precursor of cerebral apoplexy. Bleeding at the nose also occurs in certain acute conditions, notably in the early stages of typhoid fever, in nasal diphtheria, and sometimes in scarlet fever and measles. It may also occur in chlorosis, in leucocythæmia, in syphilis, and in diseases of the spleen. It may follow the suppression of cutaneous eruption, and from the sudden cessation of certain normal excretions, especially the menstrual discharge. It is commonly met with among boys at the age of adolescence, and may precede the establishment of the catamenia in girls. Sometimes in women epistaxis will be substituted for the natural menstrual flow. It may occur during pregnancy and at the menopause. It is most common in infancy, less common in older children and middle life, and again more apt to occur with advancing age.

The bleeding may come from one nostril alone or from both. It may originate in the deeper part of one nasal cavity, and, owing to some stoppage on that side, be deflected into the nasal cavity of the opposite side, and emerge through that nostril or into the pharynx. A serious feature is hemorrhage occurring during sleep and the patient in such a position that the blood gravitates into the pharynx and is swallowed. Such an accident might easily escape detection until serious loss of blood had resulted. Changing the position of the patient and causing him to clear his throat would probably demonstrate the presence of the bleeding.

HÆMATOMATA of the nasal cavities are more commonly met with on the septum. They are occasionally seen as the result of traumatism. Examination of the nasal cavity will often determine the location of the bleeding point, which is apt to be found upon some part of the cartilaginous septum. The anterior region of the nose, being more exposed to disease or injury, is the most frequent seat of the trouble.

Diagnosis.—In hemorrhage from the anterior nares the nasal cavity, having been carefully cleansed, should be examined by anterior rhinoscopy and an attempt made to locate the precise situation of the bleeding. This will generally be found in the region of the septum.

Epistaxis must be differentiated from hæmoptysis, hæmatemesis, and from bleeding from the region of the lower pharynx. This may be done by a careful examination of the nasal cavities.

The **prognosis** is generally good. Where, however, the bleeding is dependent upon a general diathesis or some systemic disease, it may be a very dangerous symptom.

Treatment.—Before attempting to treat epistaxis it is necessary to determine, as far as possible, its precise origin and cause. Vicarious hemorrhages and those occurring at the critical period of certain fevers may be allowed to continue unless excessive. If the bleeding is slight, it may be disregarded. With the plethoric also, and especially where it appears instead of menstruation, it should not be hastily interfered with. To stop the flow simple means will generally prove effective, such as absolute rest, the supine position, avoidance of allowing the head to hang forward, and standing with the head erect and the arms raised above it. The application of cold to the nose and the insufflation of cold water are effective, while the injection of water as warm as can be

borne is an excellent styptic. In all cases where it is possible, and where this can be determined, direct applications may be made to the bleeding point, the latter having been carefully dried with absorbent cotton, of nitrate of silver, of chromic acid, or of the galvanic cautery. Various astringents, such as alum and tannin, may also be used directly upon the bleeding point.

The injection of a solution of antipyrine, from ten to twenty grains to the ounce, has been found effective. If necessary, control of the hemorrhage may be gained by plugging the parts in the neighborhood of the bleeding. Anteriorly, this may easily be accomplished by packing against the bleeding surface a tampon of absorbent cotton, or, still better, one composed of a narrow strip of surgical gauze upon which some styptic—as, for instance, tannin—has been sprinkled. Occurring posteriorly, the bleeding may be checked by inserting a tampon in the nasopharynx, and, if necessary, at the same time packing the anterior part of the nasal canal. For this a flexible catheter or Bellocq's can-

FIG. 35.

Plugging the nares with Bellocq's cannula (Fergusson).

nula is used. The latter consists of a cannula curved at one end, through which is passed a curved steel spring, the end of which is protected by means of a perforated ball. In order to use the Bellocq cannula a loop of silk should be threaded through the eye in the end of the cannula. The steel should be drawn backward into the cavity of the cannula before the introduction of the latter into the nasal canal. To introduce the cannula pass the extremity with the silk loop through the nostril and backward along the floor of the nose to the posterior wall of the pharynx. Having reached the latter, thrust the steel spring forward so that it shall emerge from the cannula and appear beneath the soft palate. A tampon of cotton, lint, or sponge, saturated with vaseline, should have previously been prepared and attached to the middle of a stout piece of soft woven silk, the latter about eighteen inches long. One end of this silk should now be securely tied to the loop of silk in the eyelet of the cannula, and with the aid of the latter, assisted by the

finger placed in the pharynx, the string should be drawn forward through the nasal cavity until the tampon arrives in the lower pharynx. Here, by the means of gentle traction made upon the string, combined with careful pressure upward from the finger, the tampon should be forced into the upper pharynx and placed as desired. The tampon having been duly placed, it is well to make a firm block of absorbent cotton, around which the anterior nasal end of the string may be wound and held in the vestibule of the nose. The pharyngeal end of the string should be conducted out of the mouth and loosely attached to the patient's ear. In removing the tampon there is considerable danger that the parts may be irritated and thus the bleeding again provoked. It should never be drawn forcibly from the pharynx. The best plan, as a rule, is to first cleanse the parts as thoroughly as possible, and then apply a weak solution of cocaine in order to cause as much contraction of them as possible. While it may be considered in some cases necessary to do so, it is not desirable to allow the tampon to remain in the pharynx for more than twenty-four hours.

Severe bleeding may require the use of revulsives intended to cause reflex contraction of the nasal blood-vessels, the administration of remedies intended to quiet the action of the heart, by applying pressure internally as well as externally, and, in extreme cases, by transfusion or some kindred measure.

Ethmoid Cells.

The ethmoid cells may be the seat of inflammatory and of suppurative processes. The first condition generally complicates an attack of acute rhinitis, and in consequence is difficult to distinguish from the latter. Its presence may be suggested by the existence of pain more severe than is usually the case in simple rhinitis referred to the ethmoidal region.

Suppurative disease of the part is an affection of much greater importance, the symptoms being more severe, the most important of which is the development of caries or necrosis of the bony structures underlying the mucous membrane.

Etiology.—The disease may develop from simple acute catarrh, from a chronic rhinitis, or, in occasional instances, from traumatic causes. Local destructive processes accompanying syphilis and tuberculosis may give rise to it, although, properly speaking, conditions which they originate are of a different character from that under discussion. Whether nasal polypi are actually the cause of it, or whether they, on the other hand, owe their own origin in these cases to the irritation produced by the ethmoidal disease, is at present rather an open question. In all cases, probably, lack of free drainage of the sinus through its natural openings is the real basis of the trouble. The chief causes, therefore, may be regarded as occlusion, followed by acute and, later, by chronic suppuration.

The **pathology** is similar to that of the same condition as seen in the other sinuses. (See Vol. II. page 766.) Congestion of the mucous membrane results in sero-mucous exudation, which, being confined in a close cavity, in time degenerates into suppurative inflammation. The accumulation of pus follows, and the inflammatory process in the

mucous membrane extends through the latter to its deeper layers, which constitute the periosteal covering of the bones beneath, tending to establish periostitis. Following this, necrosis of the underlying bone occurs. The obstruction underlying all of this may be either in the continuity of the canal leading from the sinus or at the mouth of the latter, from thickening of the neighboring mucous membrane, or from some interference with the opening of the canal, due to deformity of the nose or of the nasal septum.

Symptoms.—The first marked symptom complained of will generally be unilateral pain, referable to the lower frontal region. This increases in severity, while it may extend over the whole of the face, is generally most intense at its point of origin. Early in the disease the discharge of a thick yellow pus takes place from the affected nasal cavity. In the establishment of necrosis the pus will give out the characteristic odor of dead bone. At this point also shreds of necrotic tissue may be found in it. Where great distention has taken place, the abscess may advance in the direction of least resistance, toward the orbit, causing protrusion of the eye upon the affected side, accompanied with symptoms common in such ocular disturbances. Examination will reveal the discharge of yellow pus, making its way from beneath the anterior border of the middle turbinated body. It is not easy to distinguish this condition from a similar discharge taking place from the antrum of Highmore. In the latter case it has been suggested that the pus will flow downward over the middle of the lower turbinated body, while in the ethmoidal process it will be found more posteriorly. The existence of the discharge of pus from beneath the middle turbinated body, the peculiar location of the pain, and the exophthalmos when the latter is present will all point to the ethmoid disease. The examination of the case by transillumination will sometimes make it possible to locate the disease if in the antrum of Highmore. It must be confessed, however, that in cases where distention of the cavity is not present diagnosis may be very obscure.

Treatment.—Treatment should be analogous to that pursued in similar conditions of the other sinuses. In other words, free drainage should be established, necrosed bone removed, and a thorough cleansing of the cavity maintained. To accomplish this, the process generally recommended is to first render access to the ethmoidal region more direct, if necessary, by removing as much of the anterior part of the middle turbinated body as may be required to thoroughly uncover the part. Following this, Bosworth advises that a small round or oval burr attached to the dental engine be made to enter the ethmoid cells and cause the removal of such bony fragments as may be desired. If the burr be attached to a suitable motor, its motion can be instantly arrested at will, when it can be made to act as a probe for exploring the cavity for such parts as it may be desired to remove. He does not advise that the operation should necessarily be completed at a single sitting. In many cases the process may have to be repeated a number of times at intervals varying from a week to a month and often longer.

While the procedure is not an agreeable one, it is attended with little pain, provided the parts can be thoroughly cocainized.

Bryan and other operators favor the use of a sharp spoon or curette,

and, indeed, a variety of instruments may be desirable to meet the indications in every case. When it is remembered that the cavity of the sinus is separated from the orbit by an exceedingly thin plate of bone, and that its proximity to the brain is also intimate, it will be unnecessary to urge the importance of duly appreciating the serious character of such operations, the observance of due conservatism in resorting to them, and the employment of a high grade of skill in carrying them out. It is safe to say that in no part of the body is a thorough knowledge of the anatomy of the parts more urgently necessary.

Treatment of the case after the operation should consist in thorough and persistent cleansing of the parts until relief has been gained.

Deformities of the Nose.

Deformities of the nose may be either congenital or acquired. Of the two, the latter are by far the more common.

Congenital deviations from the normal condition of the nose are sometimes found, consisting in absence or reduplication of the whole organ or of any of its constituent parts, in complete or partial closure of its canals, or in abnormalities of size and shape of certain of its parts. With the exception of the last-named conditions, which are common, these abnormalities are rare.

Absence of the nasal bones or of the nasal process of the superior maxilla is sometimes seen. Fissures associated with hare-lip and cleft palate also occur. The anterior nares are not infrequently found wholly or in part closed. Such occlusions are generally membranous. They occur at different depths. The nasopharynx is in rare instances separated from the nasal fossæ on one or both sides by a lamella of bone, and division of the nasopharynx has been observed from the septum having extended backward as far as the vertebral column. A case of double septum has been described by Lefferts in which the upper half of the posterior edge of the vomer was divided in the vertical direction into two distinct parts. In the nasal fossæ themselves are sometimes found congenital defects and malformations of the turbinated bones, of the ethmoid cells, and of the septum, as well as conditions of asymmetry of the whole structure, many of which conditions may also be acquired as the result of nasal obstruction or of syphilis, lupus, or other destructive disease.

Thus, the turbinated bones may exist only in a rudimentary form, or there may be a supernumerary one situated near the roof of the fossa; one of them may be greatly hypertrophied, while the number and degree of variations in their general form and size are almost infinite.

Asymmetry of the nasal fossæ as a whole has been described by Harrison Allen and by Zuckerkandl. In some cases it seems to be congenital, while in others it may possibly be due to a pre-existing stenosis of one nasal fossa, which while thus deprived of its proper nutrition fails to develop in harmony with its fellow.

Deviations of the nasal septum are so common as to be almost the rule. Practically, they are the most important abnormalities of the nose with which the surgeon has to deal.

Observations as to their frequency have been made by many observers,

the latest statistics on the subject giving the proportion as about 85 per cent.

Etiology.—Undoubtedly the most common cause of septal deflection is traumatism. Some of the worst cases, however, occur in those who have been mouth-breathers from pharyngeal obstruction, and in whom the disuse of the nose on the one hand, and its altered nutrition on the other, have been active causative agents in the production of the trouble.

Anosmia.

The word "anosmia," as originally used in botany, means devoid of odor, as of certain flowers. It has been adopted in medicine to mean loss or impairment of the sense of olfaction. In the latter sense it may be due either to peripheral or to central lesion. In the former case the condition may be caused by failure of the odorous influence to reach the olfactory region of the nose by reason of some obstruction in the inferior or middle part of the nasal cavity, or it may be occasioned by disease and consequent alteration in the mucous membrane in which the terminal apparatus of the olfactory nerve is located, the nerve-terminations being thus injured or at least made incapable of performing their function. On the other hand, it may be caused by central disease, as of the brain itself or of the olfactory bulbs. Of course, like blindness, deafness, and aphonia, the condition is entirely symptomatic.

Fracture of the Nasal Septum.

The nasal septum is composed of three separate parts—the cartilaginous portion, the perpendicular plate of the ethmoid, and the vomer. Any of these three parts may be fractured alone, or any part of them may partake of the injury. Fracture of the septum, therefore, may be divided into three parts: first, that of the perpendicular plate of the ethmoid; second, fracture of the vomer; and third, that of the septal cartilage.

Fracture of the perpendicular plate is not uncommon, occurring with fracture of the bones proper, especially where the fracture is extensive or comminuted. It may also be isolated, and in that case is likely to be found near the union of the perpendicular plate with the vomer.

Fracture of the vomer is rare, and not likely to be attended with displacement. It is therefore difficult to recognize.

Injuries to the cartilage of the nose may be of the nature of dislocation or fracture. The first variety is commonly met with and often difficult to remedy. The mechanism of the injury consists in the rotation of the cartilage, generally the upper segment of the tip being thrown outward into one nasal cavity sufficiently to cause it to be more or less occluded, and the lower segment being projected across the opposite cavity at a point nearer to the nostril, but still more calculated to produce occlusion, the situation, mechanically, being that of a circular valve turned partly across the free space of a hollow cylinder. The line of greatest injury may be either a transverse one along the posterior extremity of the cartilage, corresponding with its union with the perpendicular plate, or it may be horizontal and following the line between

itself and the hard palate. Generally, however, it is more or less complicated. The deformity resulting from this dislocation is not confined to the interior of the nose, the tip of the organ being thrown to one side and much injury done to the facial line. The accident is common in children, and is liable to pass unrecognized on account of the swelling which conceals it.

Actual fracture of the cartilage is more likely to happen in adult life, the cartilage in some individuals showing an early tendency to calcification, which, although not developed to an extreme degree, may be sufficient to render it comparatively brittle. It is due, of course, to direct violence, and this is generally associated with injury to the parts of the septum posterior to it. It is sometimes easily recognized, and in other cases difficult to appreciate, owing to the fact that few septa are originally straight.

The **diagnosis** is often made difficult by reason of the swelling which has taken place, but it is desirable to recognize the condition in order to overcome the deformities which otherwise are sure to result. Palpation, rhinoscopic examination—if possible, under cocaine—and the use of the nasal probe will generally give the necessary aid in recognizing injuries received within the nose.

The fact that there is no external deformity of the nose may not prove that extensive injury has not been suffered within. Generally, however, the nature of the injury may be computed by some change in its external contour, especially with regard to the tip of the nose, which will suggest the real nature of the case.

The **treatment** is a matter always requiring a considerable amount of care, skill, and judgment. In all cases great advantage is gained from an examination of the nose before swelling has taken place.

DISLOCATION OF THE CARTILAGE in children is, as a rule, impossible to remedy by any known efficient means. Complete luxation having once taken place, the base of the cartilage is so loosened that it is impossible to retain it in its normal position, and even when it is retained from the earliest period after the accident, it generally happens that the displacement will recur in spite of treatment having been carried on for a long period of time. With older subjects the case is somewhat easier, and even in children where complete healing of the parts has taken place considerable may be done at a period subsequent to the accident by surgical means. For the relief of these deformities in children Asch has attained considerable success by incising the cartilage in the lines necessary to relieve the deformity, replacing it in the median line, and causing the patient to wear for a number of weeks a perforated tube of hard rubber made to fit the parts. This tube may be manipulated by the patient after a little instruction, and its presence need not be irritating.

Operations upon the nasal septum are commonly called for and extensively practised. They may be divided in general into two classes:

1. Those for the removal of projections in cases where the normal thickness of the septum has been increased;

2. The straightening of deflected septa whose transverse diameter has not been materially altered.

These two varieties of deformity may require widely different treatment. Projections from the nasal septum may be removed by the use

of caustics, the cautery, or electrolysis. They may require the use of some cutting instrument, such as the saw, the knife, the chisel, or the forceps. The use of caustics is mainly applicable to hypertrophy of the soft tissues of the septum, and particularly those which occur on the anterior and inferior part. The galvanic cautery is of somewhat more extensive application on account of its greater destructive power. It may be used for the destruction of cartilage and even for bone. Electrolysis has been suggested, and may be used in the milder cases.

For the removal of cartilaginous and osseous spurs other means will generally be required, although the electro-cautery is sometimes useful in these. Application of these is best accomplished by some cutting instrument, the most popular of which is the simple nasal saw. The latter should be specially constructed for the purpose and of the best workmanship. The electric trephine, merely a variety of the saw, is often a valuable substitute for the latter. Variously constructed knives, scissors, and gouges are used either to separate the ridge or to reduce remaining projections after the use of other instruments.

The removal of septal spurs may be accomplished either with local or general anæsthesia. Where the operation promises to be severe the latter may be required. In nearly all cases cocaine will suffice. In operating strict aseptic precautions should be observed, notwithstanding the evident difficulty of keeping the nasal passages clear. The patient should be seated and his head firmly supported. The nasal cavity, having been cleansed, should be carefully inspected, and the exact nature, extent, and direction of the proposed incision determined upon. In using the saw it is generally more convenient to cut from below upward. Everything being ready, the saw should be introduced, the line of direction carefully noted, and as little time as possible consumed in cutting through the fragment, the operation being guided by means of anterior rhinoscopy, and every precaution taken to avoid injuring the neighboring parts. The distal end of the saw should always be probe-pointed, to avoid unnecessary injury to the membrane of the posterior part of the septum and of the wall of the pharynx, which latter, however, the saw should not be allowed to touch. The bony structures having been separated, the detached fragment should be finally separated by a smooth incision through the remaining mucous membrane, made either with the knife or scissors. In using the trephine the instrument is attached to an electric motor, and is applied by the aid of rhinoscopy to the anterior end of the projection. Revolving rapidly, it is caused to cut its way through the long diameter of the ridge.

Where the base of the spur is narrow, its removal may be accomplished with one introduction of the trephine. If it is somewhat broad, several such attempts may be required. In cases of unusual difficulty, and where the thickness of the septum will permit, a large core may be pierced through the longitudinal centre of the projection and its final removal accomplished with the nasal saw. Irregularities remaining after the use of the trephine should be removed with the aid of some suitable instrument.

The use of knives, chisels, and gouges in this country has not been general. In this class of operations, however, they have a useful place. Knives may be divided into two classes—those, like the simple chisel

or gouge, intended to be used from before backward, and those, like the instrument of Major, so constructed as to be introduced into the nasal cavity and drawn from behind forward. With the latter class of instruments should be mentioned the double gouge of Moreau Brown, the chief value of which lies in its applicability to growths situated far back in the nose when the latter are not so dense as to require the use of more powerful means. For the worst examples of the latter class of cases the electric trephine or the chisel, used under general anæsthesia, will probably give more satisfactory results.

Bleeding after operation is not usually severe, and in any case may be stopped by tamponing the nose with a narrow continuous strip of antiseptic gauze. The use of the tampon is often unnecessary, although in any case air should be excluded from the nostril.

The shock of these operations is often considerable. The patient should be warned of this, and should be treated with the same consideration, as to rest and general attention, as would apply to any other surgical condition, even slight operations upon the septum being sometimes followed by considerable general disturbance.

Deflections of the Nasal Septum.

Probably the most rational operation for exaggerated deviations of the bony septum not amenable to the methods already described, particularly if they be situated well backward and upward from the nostril, is that proposed by Adams and modified by Steele. In this a stellate incision is made, by means of an instrument designed for the purpose, through the deflected part of the septum, and the fragments thus produced are forced over to the median line, and there retained in position by a nasal clamp or by the introduction into the nasal canal of something which shall give to the operated part of the septum the necessary support. This, however, is difficult to accomplish on account of the great resiliency of the fragments. The latter difficulty may be overcome by fracturing them at their base, care being taken not to cause such injury to the tissues as to make them slough.

Blandin has advocated the removal of a small round section of the septum by means of a punch made for the purpose. A permanent communication is thus made from one nasal cavity to the other. This procedure is, as a rule, unjustifiable, as being liable to do more harm than good.

Abscess of the Nasal Septum.

Abscess of the nasal cavity rarely occurs excepting in the septum, and even here it is not very common. It is generally due to traumatism, but may be caused by extension of inflammation from a furuncle, or, more rarely, may occur as the result of irritation from severe chronic or purulent coryza. It is sometimes symptomatic of general affections, such as small-pox, scarlet fever, typhoid fever, and phlegmonous erysipelas. In rare instances, one of which has been reported by the writer, it has been idiopathic.

Symptoms.—The symptoms of acute abscess vary in intensity with the severity of the causes by which the abscess is produced and with the extent of the abscess itself. There is more or less febrile movement,

headache, throbbing, and lancinating pain, which is increased on pressure or upon blowing the nose. The inflammation at the same time extends to the face, giving it an œdematous or erysipelatous appearance. The nasal passages are obstructed, with the result of shutting off nasal respiration and causing loss of the olfactory sense and change in the quality of the voice. Secretion is diminished until opening of the abscess takes place, when it becomes purulent or sanious. Examination of the nares reveals a swelling, usually symmetrical, on both sides of the septum and generally well down toward its anterior and inferior part. The tumefaction, if at all pronounced, effectually cuts off further examination of the nasal cavity by anterior rhinoscopy, and is not reduced by applications of cocaine. The mucous membrane is red and sodden, and fluctuation may often be detected. The septum is likely to suffer perforation from destruction of more or less of the cartilaginous part, so that the abscess-cavities coalesce, and pressure upon one produces fluctuation in the other.

Cold abscess of the septum must be extremely rare, although such cases have been reported. Their onset is gradual and unmarked by the acute symptoms described above.

The course of acute septal abscess may be exceedingly rapid, and early **diagnosis** is therefore of great importance, since, if treatment be delayed, extensive destruction of the septum and marked external deformity of the nose may result.

In the case of an acute abscess the **diagnosis** may be made with comparative ease. Chronic abscess may be identified by the presence of fluctuation, particularly if the septum has become perforated, and, if necessary, aspiration may be resorted to as an aid to the diagnosis.

Abscess of the septum may be complicated with facial erysipelas, destruction, more or less extensive, of the bones and cartilages of the septum, and even of the nose itself, and possibly by meningitis and phlebitis. Of the sequels most likely to follow, loss of the septum and consequent deformity of the nose will take precedence.

Treatment should be both general and local. The former will be suggested by the necessities of the case in hand. The local condition should be treated with great promptness and thoroughness. If an abscess is impending, efforts should be made to dissipate it by means of inhalations of steam, or, if necessary, by scarification. As soon as the presence of pus can be detected, free incision should at once be made into both sides of the septum and at a point from which the cavity can be well drained. Should the septum be perforated, drainage may be effected by means of several strands of lampwick, silk, or other suitable material passed through the incisions. Meanwhile, absolute cleanliness of the nasal passages should be maintained by means of some mild antiseptic solution, and everything possible done to hasten resolution.

Perforation of the septum is not uncommonly met with. It may be due to the effects of syphilis, lupus, or malignant disease situated near the junction of the anterior cartilage with the bony septum, but is far more often of the simplest possible origin and devoid of present or prospective danger.

SURGERY OF THE MOUTH AND TONGUE.

By HENRY H. MUDD, M. D.

THE mouth is prolific in the variety of the surgical complications which it exhibits. Many of these complications arise from diseases which originate in structures outside of the oral cavity, but which give it outline or are contiguous to it.

The tongue is the organ of chief surgical interest in the mouth. There are some developmental deformities and local inflammation of other parts which require consideration.

DEFORMITIES.

The developmental deformities of the mouth, aside from hare-lip, cleft palate, and tongue-tie, are not very frequent. Yet the lips may be too large and thick, the tongue imperfectly or excessively developed or displaced, the roof of the mouth may have its arch too acute, or the lower jaw may be imperfect and diminutive in size.

MACROCHELIA.—Thick, everted lips constitute now and then a distinct deformity. The hypertrophied lip is thick, slightly everted, and less pliable than natural. The condition is one of lymphœdema. There are two forms of this thick hypertrophied lip. The more common form is found in the dense, inelastic, smooth, everted lip, where all of the tissues appear to be increased. This is most frequently due to repeated inflammation accompanied with œdema and lymphatic hypertrophy. It may be congenital in its origin. The deformity is often quite serious. In the second and less frequent deformity the lip, although thick, is covered with a rough, wrinkled mucous membrane, or is pouched, having two distinct pouches, one on either side of the median line. These folds are generally on the inner surface of the lip, and are best exposed to view by eversion of the lip and separation of the cutaneous margins. These pouches contain mucous glands, lymphoid tissue, and fat. The everted wrinkled mucous surface of a thick lip suggests a gradual absorption of the tissue of the lip, such as might follow the arrest of a chronic lymphangitis. It is a sequel in some cases, no doubt, to the thick, smooth, redundant lip first described.

The treatment of the hypertrophied lip first described should be both constitutional and local. The general treatment should be directed to the improvement of the general condition of the patient, for it is associated with the strumous habit. The deformity is so marked in some cases as to demand the excision of a V-shaped piece from the lip. The operation is best made with the scissors, though the knife can be used to good advantage if the V is a long one. The cut surface should

be accurately approximated, either with hare-lip pins or with silk sutures.

The wrinkled condition of the mucous margin may be materially relieved and much improved in appearance by the excision of a long oval piece of mucous membrane of the lip and the approximation of the margins. The inner line of the incision should be placed well in toward the mucous surface of the lip and parallel with it.

In the pouched lip the redundant tissue should be removed by excision with the knife. An oval incision is made to include the pouch, and the hypertrophied tissue is dissected out. It is often necessary to remove more of the hypertrophied tissue of the under surface of the lip than can be included between the lines of incision on the mucous surface in order to get easy and perfect approximation of the margins. This dissection is made in the body of the lip, chiefly from the under surface.

MACROSTOMA, OR FISSURE OF THE CHEEK.—It is rare to see a mouth so small on account of developmental errors as to be a serious deformity. A mouth too large is not so infrequent. The oval slit may be so great as to demand attention because of the marked developmental error which results from the non-union of the buccal cleft; that is, where the superior maxillary and the inferior maxillary portions of the mandibular arch fail to unite. A fissure in the cheek, usually unilateral, may extend as far back as the masseter muscle. This deformity is quite rare. It is amenable to operative procedure, good results being obtained by plastic operations. Supernumerary auricles accompany this error of development. These auricular appendages are, however, much more frequent than the fissured cheek.

The deformities of the superior and inferior maxilla which change the outlines and disturb the functions of the mouth will be more properly considered with these bony structures. The tongue has, it is said, been observed to be congenitally absent. A bifid tongue is described, but it must be very rare, though a slight notch in the median line at the tip is very frequent. A lack of symmetry in the development of the two sides of the tongue is not very infrequent, one-half being smaller than is natural.

The most frequent irregularity in development is in the frænum, which may be shorter and thicker than it should be or extend farther forward, as a thin, firm band, than is compatible with the free natural movements of the tongue. This condition of tongue-tie is found frequently, and a well-marked case prevents protrusion of the tongue beyond the teeth and makes it difficult or impossible for a child to suck. Every degree of limitation in function from this almost complete loss to a full, free motion may depend upon the varying length and point of attachment of the frænum. It is often associated with the short, broad-tipped tongue, which shows a little central notch and the median raphé more distinct than usual. This condition is not uncommonly associated with idiocy. Children with imperfect mentality are very often brought to the surgeon for the purpose of having the frænum clipped. In the majority of cases offered for the operation by anxious parents nothing markedly abnormal can be observed in the frænum. The two conditions, defective mentality and the broad notched tip of the tongue, may be associated errors of development.

Tongue-tie is a disabling condition, but it is easily rectified by clipping with the scissors the short band which prevents free motion. It is well not to cut too close to the tongue-tissue, as a free incision might thus injure the ranine artery. The usual method employed to cut the frænum is simple and effective: The broad end of a grooved director is pushed under the tongue, so that the frænum rests in the slit; the tongue is lifted up, and when the frænum is made tense it is cut by using the scissors. The line of the cut should be inclined toward the floor of the mouth, rather than up toward the tongue-tissue. The fingers may be used to lift the tongue as well as the director. Treves mentions a remarkable case in which, after division of the frænum, a continued laceration of the tissues under the tongue so far freed it from its anterior attachments that it rolled back into the pharynx and suffocated the child.

ADHERENT TONGUE.—Irregular mucous folds may exist which bind the tongue to the floor of the mouth, producing the condition recognized as an adherent tongue. These folds or adhesions may be congenital or acquired. The tongue may be displaced. Dr. W. H. Thorndike of Boston has reported a case in a woman twenty-eight years old: "The tip of the tongue was bound down to the tissues in front of the hyoid bone."

MACROGLOSSIA.—An hypertrophy of the tongue or an overgrowth of the lymphatic tissue of the tongue, beginning in embryonic life or soon after birth, either in an impulse of development or as a result of an inflammation of the tongue, is a well recognized condition. The overgrowth is composed of interstitial connective tissue with dilated lymphatic trunks and enlarged blood-vessels. These elements of enlargement vary in their relative proportions in different cases, hence the varying degrees of density of the organ observed in macroglossia. The enlargement consists generally of a lymphangeioma of the mucous surface. It is not often prominent before the second year of life, but uniformly finds its development in childhood. As the tongue increases in size it protrudes between the teeth and lips. It interferes with speech, mastication, and respiration. If it develops early, the child may never have learned to talk. Liquid nourishment only can be used if the hypertrophy is great. The respiration may be entirely nasal. The hypertrophy is chiefly in the anterior portion of the tongue, and the organ does not encroach upon the larynx. The constant protrusion of the tongue between the teeth and the lips changes the outline of the parts. This protrusion may be so great that the tongue may not only overlap the chin and jaw, but may touch the sternum. The mass is dense, heavy, and immobile, the surface dry and rough. The condition is most distressing. As it is essentially a disease of early life, the change in the configuration of the parts subjected to pressure may be very radical and rapid. These changes are very well described by Dr. L. McLane Tiffany in the history of a case: The boy, colored, was aged five years. An acute abscess in the tip of the tongue formed when the boy was a month old. The tongue remained large and protruded from the mouth after the development of the abscess. Dr. Tiffany says: "The tongue continually protrudes; it can be retracted the distance of one inch only; the tip cannot be raised by the lingual muscle, but rests always against the chin. The upper surface is dry, fissured, and covered with a thick

coating of epithelium, which can be scraped off without much force. The under surface resting against the lower jaw is marked by a line of ulceration, posterior to which the openings to Wharton's ducts are seen. The lips rest against the surface of the tumor. Breathing takes place by the nose. The four lower incisor teeth are wanting; at their site the jaw presents a sharpish edge directed forward, the weight of the tumor having changed the direction of the symphysis at the chin from nearly vertical to horizontal. The lower canines are displaced outward and forward. The upper incisors are directed forward horizontally, the usually posterior surface resting upon the tongue. The upper canines look outward and forward. The molars can be brought together. Along the upper convex surface of the tongue the length is two and a half inches from teeth to tip; along the lower surface, two inches. After removal of the tongue the aperture in which it rested between the jaws measured two by one and a half inches."

The constant effort of the sucking baby to obtain food is probably one reason why this hypertrophy is not noticed earlier. After the tongue once escapes permanently from the mouth the tendency is to an unlimited growth.

I do not know of any recurrence after excision, but there must, from the nature of the disease, be occasionally a relapse. The pressure maintained by keeping the mouth shut must exercise a restraining influence on its primary development or its recurrence. The ligation of the lingual arteries should also be a good prophylactic measure

Treatment.—The redundant mass should be removed. The knife and the scissors are to be preferred, for the operation should be not only one of excision, but should also be plastic in character. The knife and scissors give edges which can be approximated, and which heal more promptly than the sloughing surface left by the écraseur or the cautery. There is less destruction of tissue, and prolonged suppuration may thus be avoided. The sloughing surface left by the écraseur or after cauterization subjects the patient to greater danger of septic pneumonia or diarrhœa.

Hemorrhage during excision can be controlled by pulling the tongue strongly forward out of the mouth. The tissues about the base of the tongue are not dense and firm, and the hyoid bone and larynx are free in their movements, so that strong traction on the tongue will put the lingual artery on the stretch. After the excision has been completed the traction can be maintained by putting the finger behind the epiglottis and pulling forward the base of the tongue. The most secure and satisfactory method of controlling hemorrhage is, however, by primary ligature of the lingual arteries. The hemorrhage is then so slight that the excision is easily and accurately made. The adjustment of the stump by the approximation of the cut surfaces can then be made more or less perfectly according to the lines of the incision which were necessarily made in the extirpation of the diseased tissue.

A gag for keeping the mouth open is essential in operations upon the tongue. A most efficient gag is a truncated wedge of hard wood long enough to be grasped firmly in the hand of a good assistant. This assistant at the same time holds the head. The bilateral gag, like the Hutchinson gag or Smith's, limits the working space. A gag which is

applied only on one side answers the purpose best. There are many varieties of these: Denhard's, a modification of the O'Dwyer gag, is a good one. The gags of Allingham, of Coleman, and also of Mason Croft are good and are not in the way of the operator. They must be strong and heavy or they will bend and yield under the strain put upon them. The Luer gag is strong and durable, and is well devised for efficient use.

APHTHOUS SORE MOUTH.—This inflammation of the mucous membrane of the mouth occurs most frequently in badly-nourished children and adults, and is evidenced by the presence of white patches on the cheeks, the gums, or the tongue. It is a simple follicular inflammation, manifested by little aphthous patches somewhat irregular in outline, which, when the film is rubbed off, leaves red, sensitive, denuded points. It is also quite a frequent accompaniment of indigestion in healthy subjects. It is transient in character, and disappears as the digestive functions are re-established.

THRUSH is parasitic in its origin, and is generally diffused over the oral cavity. A grayish-white film of irregular thickness is formed which is more or less continuous over large areas of the mucous membrane of the mouth. The oïdium albicans is found to be present in the film which is rubbed from the denuded surface in thrush. It is occasionally epidemic, and a large number of otherwise healthy individuals in a given community may become infected as a result of uncleanliness. It is common in children during dentition, and appears frequently in individuals whose general condition is depraved from long-continued gastro-intestinal disturbance. It may follow the exanthematous diseases, as also typhoid fever, phthisis, carcinoma, or diabetes mellitus. The nostrils and larynx are generally exempt. If thrush appears in marasmic children or in adults with incurable disease, it is difficult to check its growth and to free the patient from its annoying and troublesome symptoms.

Aphthous patches, if due to temporary disturbance of the health, may disappear rapidly under the use of local cleansing antiseptic washes or the use of caustics, such as nitrate of silver or chromic acid. Boric-acid wash or a solution of permanganate of potash, or a thorough cleansing of the mouth with warm water, may arrest the spread of thrush. There is no doubt, however, but that oft-repeated rough washing of the delicate mucous surface of the mouth in children lessens the resisting powers of the membrane and invites or maintains the disease. A wash of chlorate of potash is an efficient remedy in this form of stomatitis.

NOMA, GANGRENOUS STOMATITIS, OR CANCRUM ORIS.—Now and then a child develops, after some acute disease or long-continued marasmus, a gangrenous spot on the inner surface of the cheek, which extends in area and depth until the entire thickness, if not the whole extent, of the cheek is involved in the slough. This is the result of a mixed infection, but it appears without special warning, usually as a small discolored spot on the inner surface of the cheek near the angle of the mouth. The tissues of the cheek become infiltrated and brawny. The contiguous lymph-glands are enlarged, fever is high, and acute septicæmia, with its consequent depression and exhaustion, ensues. The inhalation of septic particles may excite a lobular pneumonia, and the ingestion of gangrenous material may provoke a violent diarrhœa. It

is a serious, generally fatal, disease, and when recovery does occur it leaves an ugly deformity of the face and impaired function of the jaws.

The treatment should be prompt and radical. Free incisions should traverse the entire infiltrated arch. These should pass through to the skin-surface if necessary, but always deeply into the tissues beyond, or at least through, the dense infiltration which precedes the slough. Free cauterization with the thermo-cautery may follow these cuts. The iodoform-gauze packing in these incisions is to be preferred. It will favor drainage and deplete the infiltrated tissue, and help to avoid infection of the lungs or the digestive tract by the protection it gives to the surface of the wound. The cauterization checks any depletion through the cut surface, and does not offer as reasonable a prospect of arresting the local destruction as the gauze packing. Every effort should be made to protect the patient and the incisions from the foul exhalations which originate in or pass through the mouth. Disinfectants should be used freely. Stimulants and nutritive fluids should be administered to the full extent of the tolerance of the stomach.

GINGIVITIS, OR SPONGY GUMS, may occur in connection with scorbutus. The gums become soft, thickened, and bleed readily and at times profusely, and are loosened from their attachment to the teeth. The condition also obtains occasionally as a result of malaria. It may find local origin in Riggs's disease. Gingivitis is an inflammation of the gums generally dependent upon some constitutional cachexia; hence it is important to understand, if possible, the general condition of the patient. The disease is not usually of local origin.

Diet is the chief factor in the treatment if the disease is scorbutic in its origin. Quinine at times gives prompt relief. Local treatment should include the thorough cleansing of the mouth and gums. The use of astringent antiseptics, such as tincture of myrrh or rhatany, is useful. The tincture of iodine, a chlorate-of-potash wash, and salicylic- or boric-acid solutions are useful as topical applications in its treatment. Tonics and the correction of digestive and nutritive defects are of first importance.

GUM-BOIL.—This may be superficial and due to traumatism or to infection from spongy gums, but it is far more frequently due to a diseased tooth. Its usual source is from an inflammation of the peridental membrane about a diseased fang. The nerve of the tooth decays or becomes inflamed, and the tissues at the apical space become involved. The nerve as it enters the tooth, the vascular bone about the apex of the fang, and the soft tissues in the space, all respond to the irritation of the inflamed and decaying nerve-filament of the tooth. The tooth becomes loosened in its socket by the congestion and the infiltration of the tissues about the root, and it is pushed out, so that it comes readily into contact with its opposing tooth. This apical periodontitis is very painful and the tooth becomes sensitive. The bone-tissue about the root softens, and the space about the end of the root enlarges by absorption of the vascular bone, and suppuration follows. This little abscess forms in the alveolar recess about the diseased fang as a result of the infection which is established by the decaying nerve. The gases and the fluids are set free at the apex of the root; the matter seeks an exit through the alveolar process or along the diseased fang. If, happily, it finds a direct

exit through the bone and the gum, the relief obtained by an opening established by the ulceration on the free surface of the gum or by lancing it is prompt and efficient. This may be hastened by the surgeon breaking through the alveolar process and giving vent to the pus before it can make an exit for itself. The dentist can cut short the suffering, and sometimes prevent suppuration, by drilling into the nerve-canal and thus give drainage through the tooth. If the dead nerve can be removed and the nerve-canal be so thoroughly cleansed as to render it antiseptic, the abscess may be avoided. These alveolar abscesses are always painful. The first one is usually much more severe than the secondary ones which are apt to follow the imperfect healing which leaves an infected point about the apex of the tooth or in the nerve-canal. These secondary abscesses usually find vent more quickly through the wall of the socket, which has already been softened by the primary inflammation.

The alveolar process, and even the body of the jaw, may be so involved in these abscesses as to become necrosed. A number of teeth and a large part of the jaw may be destroyed by the extension of an inflammation produced by an alveolar abscess or gum-boil.

The abscess or swelling about an inflamed tooth should be promptly opened. The cavity may be thoroughly cleansed by use of peroxide of hydrogen. The opening should be kept from closing until the tenderness of the tooth has subsided and the discharge has ceased.

LIPS.

Chaps and Fissures.—Fever blisters are frequent sequelæ of the transient fevers of malarial or digestive origin. The herpetic affection is mild and results in a bleb, the exfoliation of the superficial surface of the lip, and recovery. Inflammatory infiltration not infrequently involves the thickness of the lip, but quickly subsides and rarely suppurates. Exposure of the lips to cold produces a roughened condition in many persons. In some cases this is very persistent, and it is difficult to control during the winter. Fissures which are deep and painful, bleeding readily on touch, form in the lip. The simpler cases of chapped lips require protection only from moisture and cold to ensure recovery. Simple ointment or rose ointment serves a good purpose. The deep fissures are best controlled by caustic applications of nitrate of silver or chromic acid. These must be repeated if necessary. Protection must be afforded to the raw surface, and may be secured in the eschar formed by caustics or by plasters, or by the use of balsam and plastic collodion. Chromic acid is most useful in the treatment of these fissures. The fissures which result from syphilitic infection in the child or adult need, of course, specific treatment, as well as the local attention above outlined.

Mucous cysts form on the free margin of the lips near the inner border. They develop slowly and are easily recognized, for they project from the mucous surface as a rounded, elastic, fluctuating, thin-walled cyst. The mucous membrane over the surface of the cyst is smoother and less vascular than normal. If they attain the size of a hazel-nut, the deformity is quite marked. The thickening of the lip produced by the smaller ones is noticeable. The cyst should be dissected out. The

incision should always be on the mucous surface of the lip. It heals readily and the cure is uniformly perfect.

The lips are exposed to infection and to many injuries. They are subjected to extremes of heat and cold. This exposure may result in blisters or in the chronic inflammations indicated by roughened or fissured lips. Chancres not infrequently develop here. The infection is usually the result of contact with mucous patches in the act of kissing. This is also a favorite site for the development of an epithelioma as a result of long-continued traumatism from the pipe, the cigar, or the cigarette. These, however, are best considered elsewhere.

Injuries.—Clean cuts with sharp instruments are common. The contusions and lacerations which are inflicted by blows are very frequent. The lips are forcibly driven against the irregular line of the teeth and cut or torn by them. The lacerations may involve only the mucous surface or extend through the entire thickness of the lips. The swelling of the lips after contusion and laceration is often very great, though it is seldom that an abscess forms. The slight lacerations which involve the mucous membrane and the subjacent tissue only do not need to be approximated by suture. Indeed, deep lacerations of the inner surface of the lip which do not involve the margin of the lip or break the skin-surface heal kindly and without much suppuration. They are bathed in the secretions of the mouth and subjected to many chances for infection, but generally make satisfactory progress and sound healing.

Treatment.—Drainage for the deep lacerations is maintained by the moist mucous surface of the wound. Cleansing of the mouth and of the wound-surface by washing is proper and helps to security from infection. Those rugged, torn wounds which involve the entire thickness of the lips are best treated by trimming the lacerated edges and securing smooth, even surfaces for approximation. A fresh, clean cut in the lip heals readily if the approximation is prompt and perfect. If the cut involves the entire thickness of the lip, the union may be secured by the use of pins and the figure-of-8 suture. This steadies the lip and gives excellent approximation. The silk suture traversing the entire thickness of the lip is, however, efficient and answers every indication well, unless there is great tension. These sutures should be removed on the third or fourth day. The lips are vascular and well nourished and the repair is prompt. The great vascularity and rapid nutritive changes in the lips, especially in children, will provoke ulceration about the sutures if they are too tightly drawn or there is much tension on them. If the suture be antiseptic and does not penetrate the mucous surface, and is placed without constricting the part, it may remain longer without damaging the tissues by ulceration. The portion of the suture exposed on the skin-surface can be kept dry and free from infection.

TONGUE.

The tongue is a reflex of many constitutional conditions, notably those which involve the digestive tract. The exanthemata,—viz. scarlatina, variola, and varicella—often show special characteristics on the tongue. Dermatoses of the tongue, such as herpes, pemphigus, purpura,

psoriasis, lupus, etc., are almost always associated with similar lesions on other parts of the body.

Stomatitis.—The tongue is perhaps more frequently involved in both the acute and chronic form of stomatitis than other parts of the mucous membrane of the mouth. The term stomatitis has been somewhat carelessly applied in widely-different conditions of the mouth, from a simple congestion of the membrane, with rapid exfoliation of the epithelial cells, to the more dangerous conditions which result in cancrum oris or noma. It may appear at any time of life. It is most frequent, especially in its severer ulcerative forms, in childhood.

A simple form of stomatitis frequently accompanies dentition. Simple local irritants, such as rough teeth, carious teeth, hot liquids, highly-seasoned food, tobacco, acid or alkaline substances, will produce it. Traumatisms variously inflicted upon the tissues of, or contiguous to, the mouth may excite a stomatitis more or less severe.

Simple stomatitis is evident in a congested mucous membrane, a furred and swollen tongue, showing the impress of the teeth clearly outlined on its margins. The accompanying foul breath and bad taste indicate a general disturbance which accompanies the local irritation. This condition is very apt to occur in patients with lowered vitality and impaired nutrition who have any gastro-intestinal disturbance. The more acute attacks may develop a reddened, sensitive condition of the tongue, the gums, and the cheeks.

The duration of a simple acute stomatitis is from a few days to two weeks. These local symptoms are often the result of a subacute exacerbation of a more or less chronic condition. The regulation of the diet, the removal of local irritants, the restoration of the tone of the general system by rest, sleep, and the avoidance of any excesses, generally bring prompt relief. The use of cleansing antiseptic washes hastens recovery.

Circumscribed local inflammations of the tongue are common. They may be produced by persistent local irritation. Certain constitutional disturbances thus find local expression.

Smokers, especially if a pipe with a short, rough stem is habitually used, generally show a coated tongue. A portion of the anterior upper surface may show a reddened, sensitive surface, a so-called "smoker's patch." The lines between the fungiform papillæ are deeper and the filiform papillæ are prominent. [The surface looks raw, and may involve one-third or one-half of the surface of the tongue. The remaining portion of the tongue is likely to be furred with a thick white coat.

If the irritation of continued smoking is maintained, the corium becomes thick and white and a well-formed plaque results. This white, smooth spot may be extensive and persistent. The so-called "glassblower's patch" is also produced by long-continued irritation, and is of the same character. These white patches are known under various names—viz. leucoplakia, leucoma, leucoplasia, and chronic epithelial stomatitis. They appear either on the upper surface or on the sides of the tongue. Rough, carious teeth occasionally develop such patches.

White plaques of varying size, showing loss of normal epithelium with atrophy of the papillæ, are the final result of long-established local

inflammation. The surface becomes smooth, white, and, if old and chronic, is a little depressed.

Treatment.—Any local irritation is to be removed and all digestive disturbances corrected, if possible, by proper diet and hygienic care. The spot is slow to disappear even under treatment. Mild local stimulation favors the restoration of the part. This is accomplished by the weaker solutions of chromic acid.

Syphilis, or the mercurial stomatitis so often accompanying it, is a source of leucoma. The leucoma or sclerosed patch of tertiary syphilis is chronic, and is apt to become fissured and irregular and to form ulcers. The mucous patch so often present on the tongue in secondary syphilis is more transient than the well-formed leucoma. The mucous patches are multiple, and are situated most frequently on the sides and tip of the tongue, though the areas inflamed may cover most of the dorsum and be serpiginous in character. The surface involved is elevated, the tissue is thickened and somewhat sensitive.

The initial lesion of syphilis, or chancre, occurs occasionally on the tongue. It is usually situated near the tip. The continued traumatism to which it is subjected by the motion of the tongue usually determines ulceration. The tonsil is, however, the most frequent situation of a chancre in the mouth. Syphilitic nodules or gummata form in the substance of the tongue. They are usually situated in the body of the tongue in its posterior segment. They are generally multiple and are late manifestations of the disease.

Treatment.—These syphilitic manifestations require specific constitutional treatment. The primary sore needs the usual treatment. Local applications of nitrate of silver or chromic acid produce a marked influence on mucous patches. The deliquescent chromic acid applied with a match or probe having cotton wrapped snugly about its end is a most useful remedy. The tertiary manifestations need only constitutional treatment unless they ulcerate.

Superficial Glossitis.—The slight traumatisms of the tongue, the leucomatic patch, the smoker's patch, glassblower's patch, ichthyosis, and simple stomatitis exhibit varied forms of a superficial glossitis. This is often most persistent and troublesome. It may exist for many years without developing dangerous conditions. Cancerous nodules and fissures may result from its long continuance.

Glossitis.—Acute inflammations involving the entire tongue are rare. A lymphangitis of the tongue or an acute glossitis may occur as a result of infection. It should be borne in mind that the median raphe of the tongue is well marked and fibrous in character, and that such an inflammation may be, though rarely, limited to one side of the tongue, producing a hemiglossitis. A glossitis is said to arise from catarrhal conditions, but an excoriation with subsequent infection is more frequently the source of this acute diffuse inflammation. It also follows traumatisms.

Foreign bodies lodged in the substance of the tongue may promptly or long after the primary injury excite an acute glossitis, with development of an abscess. Erysipelas is occasionally an exciting cause of a dangerous character. The tongue swells, and, though not excessively painful, produces great distress, for swallowing is difficult and the res-

piration becomes labored. The tumefaction is so great that the base of the tongue pushes the epiglottis backward, so obstructing the pharynx that suffocation may occur. The tongue fills the mouth and protrudes between the teeth and lips, but it does not simulate the condition described as macroglossia, which is an hypertrophy of the anterior section of the tongue. The inflammatory enlargement involves the body and the base of the tongue. It is softer and more boggy than the chronic enlargement which constitutes macroglossia. It is accompanied by fever and constitutional disturbance. In the erysipelatous form the glands under the jaw and about the angle are apt to be involved. The toxæmia may be profound and death occur promptly. In a fatal case of erysipelas of the tongue which came under observation death occurred during the second day, though suffocation was avoided by tracheotomy.

The **treatment** of acute glossitis should be prompt. Free and deep incisions are the chief reliance. The incisions should be made in each side of the tongue. Hot cleansing washes should be used in the mouth, and external applications of moist lint are beneficial. The simpler cases usually recover in four or five days. An abscess of the tongue is usually developed in the anterior portion. Pus forms rapidly, and the circumscribed boggy area should be promptly incised and the pus evacuated.

Subglossitis may follow compound comminuted fracture of the lower jaw or develop after operations in the sublingual tissues. It is in loose connective tissue, and the swelling is prompt and sometimes excessive. The tongue is pushed upward and backward, so that its dorsum and tip rest against the palate. Deglutition is difficult or impossible, and the respiration is through the nose. It is not likely to produce suffocation, for the firm tissue of the base of the tongue prevents its encroachment on the pharynx. It may suppurate.

Free incisions and free drainage, if the disease is connected with an external wound, are essentials in the treatment. The evacuation of any pus which may form is of first importance. When the tongue is enlarged it cannot serve its purpose as a cleansing agent in freeing the pockets in the floor of the mouth, in the cheeks, or about the teeth; hence thorough artificial cleansing must be carefully maintained. The secretions of the salivary and mucous glands are not offensive to wounds or provocative of local inflammations, unless they are mixed with offensive matter. If they bathe the wounded surface when so contaminated they may be a source of infection.

WOUNDS of the tongue are rather common. They are most frequently produced by the teeth. Epileptics are apt to bite and often severely injure the tongue. A boy running may fall and, with tongue protruded, strike his chin in such a way as to almost completely sever the anterior portion of the tongue from its body. Blows upon the chin may inflict the same damage. Pipes, pencils, or other sharp bodies may, by various accidents, be thrust into the tongue. Teeth, fragments of bone, and bullets find lodgement in the tongue. If the long stem of a pipe or a long splinter be imbedded in the tissue, its relations should be carefully considered before the removal, as it may have penetrated important structures contiguous to the deeper part of the organ. The punctures and penetrating wounds become serious if they are very deep. A careful examination of the tissues on the side of the neck and near the

angle of the jaw should be made, in order to be sure that the great blood-vessels are not involved, as this complication might require preliminary operation for their ligation to prevent undue hemorrhage.

Many of the slight injuries inflicted upon the tongue by the teeth require no special treatment. The more extensive wounds thus inflicted must be treated as lacerated wounds. It should be remembered that the tongue may be almost severed by a clean cut with knife or teeth, and yet unite readily and quickly if properly approximated. The hemorrhage from minor wounds and cuts is usually not severe, and spontaneously ceases, or is easily controlled by cold, by styptics, or by sutures used in approximating wounded surfaces. Oozing from hæmophilia may be difficult or impossible to arrest. A bleeding vessel, injured by a cut or by laceration, should be tied at the site of the injury. The lingual arteries can be readily secured at the point of selection if the hemorrhage should be excessive and otherwise uncontrollable, or if the artery at the point of injury is inaccessible. Danger from hemorrhage in infants or in adults in a comatose condition may arise, not necessarily from the amount of blood lost, but because it may trickle into the larynx and produce suffocation or inflammatory complications. Excessive hemorrhage may be concealed by its escape into the œsophagus and the stomach.

Treatment.—These incised or lacerated wounds of the tongue must be carefully adjusted and held in position by silk sutures. The suture should be small, and it must be very carefully tied. The knot of a large, coarse suture becomes loosened more easily than that of a smaller one. The suture is always moist, and the tongue is in motion rubbing against the teeth, the cheeks, and the palate; hence sutures are quickly untied unless carefully tightened and securely knotted. The wounds usually unite well, though not perfectly. The scar is a depressed line or groove. Foreign bodies require removal. The wound of entrance in the deep penetrating wounds should remain open, or, if drainage is essential, it may be necessary to enlarge the opening.

Keloid growths may form in the scars resulting from injuries to the tongue. They are subject to the same treatment as elsewhere. They have a limit to their growth, and it is best to let them alone if consistent with the welfare of the patient.

Ulcers.—Circumscribed inflammations of the tongue, resulting in ulcers, are frequent. These may be simple, mechanical, or traumatic in character, or may be the result of tuberculosis, of syphilis, or of cancer. They occur much more frequently in men than in women.

Simple ulcerations of the tongue are often mechanical in origin; a carious or rough tooth provokes them. They are on the sides or tip of the tongue. In whooping cough it is usual to have an ulcer more or less marked form on the frænum. It is said that they do not occur unless the child has cut the lower incisor teeth. Simple ulcers usually make prompt recovery after the removal of the source of irritation. The ulcer provoked by mechanical irritation may become deep and ragged, be surrounded by a thickened, inflamed border, and be slow to heal. Aphthous and dyspeptic ulcers may be deep and ugly, though they are usually superficial and disappear as the general condition improves.

Tubercular ulcerations form near the tip of the tongue. The well-

formed ulcer shows sharp, well-defined, abrupt edges, not much undermined or overlapped. The surface of the ulcer is smooth, red, and sensitive. The central portion may present a yellowish, dirty surface. They are usually small, though the ulcer may be quite deep and extensive. Topical applications have but little influence on them, and they are difficult to heal. They are generally a secondary, not a primary, manifestation of tuberculosis. Scrapings from the surface may show the tubercle bacilli. The tubercular ulcer is a disease of young adults or of middle life, and is accompanied with other tubercular manifestations; hence the diagnosis is not entirely dependent upon the local manifestations. The edges of this ulcer do not show the wide, dense infiltration of the malignant ulcer. Absence of a syphilitic history helps to the formation of a diagnosis. There may be an involvement of the lymphatic glands of the neck accompanying tubercular ulcers, though they are not necessarily consequent upon the ulcer. Syphilitic ulcers are of two quite distinct varieties. The mucous patches forming the superficial, transient ulcers of secondary syphilis are multiple, and are situated along the edges of the tongue. They are quickly influenced by topical and constitutional treatment, and generally disappear without leaving permanent scars. Fissures and cracks on the dorsum, single or multiple, are generally the result of tertiary syphilis. The deep ulcers of syphilis are tertiary. The glands, as a rule, are not involved in the tertiary manifestations. These ulcers are situated on the dorsum of the body or toward the base of the tongue, and result from the breaking down of the gummata. They are ragged, dirty-looking ulcers, with a sloughing surface and overlapping, undermined, irregular margins. This syphilitic ulcer is rapidly developed by the softening of tissues already diseased. The induration of the tissues of the tongue precedes the formation of the ulcer, but as the ulcer extends the induration of the tissue does not keep pace with it. Other points of induration are apt to be present in the tongue. One nodule may ulcerate and open into an ulcer already formed, thus giving a more irregular and extensive outline to a cavity already existing with undermined edges.

Ulcers of the tongue cancerous in character are an incident in the progress of epitheliomatous growths, and are best considered in connection with tumors of the tongue.

The differential diagnosis between tubercular and syphilitic ulcers and the cancerous ulcer can be usually made, for a cancerous ulcer is preceded by an indurated, painful area, and is usually situated on the side of the tongue. The ulcer, when distinct and well outlined, never reaches the border of the indurated margin, as it may in both the tubercular and syphilitic ulcer. It is never a clean ulcer. It is almost always painful, and is steadily progressive, and it very often finds its origin in psoriasis of the tongue. The lymphatic glands are almost certain to be enlarged, though often difficult to detect. The cancerous ulcer is most frequent between the forty-fifth and the sixtieth years. It is single, rarely multiple. A careful estimate of the general history of the individual and a close observation of the local conditions, with, finally, a microscopical examination of the tissues of the ulcer, will generally enable the surgeon to determine or exclude cancer. If there is a serious doubt about the condition, give the patient the benefit of the doubt, and

excise the ulcer and the contiguous parts, together with the infected glands.

Treatment of Ulcers of the Tongue.—Cancerous ulceration of the tongue has but one treatment—complete extirpation of the diseased tissue. It should not be confounded with other forms of ulceration and treated by applications or constitutional treatment. The simple ulcerations of aphthæ, dyspepsia, and traumatism are apt to be transient and disappear with the removal of the cause, if that is possible. They require cleansing applications, such as a solution of chlorate of potash, peroxide of hydrogen, boric acid, etc. Stimulating applications of nitrate of silver, solutions of chromic acid, and the powdered hydrastis canadensis are beneficial. Chromic acid applied directly to these ulcerations, in strength varying from gr. x to the deliquescent crystals, is a favorite remedy. Care should be used in applying the strong solution that it does not spread to healthy tissue. Tubercular and syphilitic ulcers are benefited by the same topical treatment, but they require different constitutional treatment. The tubercular ulcer requires the exhibition of tonics, while the deep syphilitic ulcer yields readily to the use of the iodides. The persistent tubercular ulcer is frequently best treated by a clean excision and the approximation of the edges. This is a proper and conservative measure when the constitutional condition warrants it. The tubercular ulcer is often painful and interferes with nutrition. Curetting is not so beneficial here as in many cases of local tubercular deposits. The excision is often curative.

ACTINOMYCOSIS OF THE TONGUE is dependent upon the invasion of the tissues by the ray fungus. The tumor developed by actinomyces, or the ray fungus, is an infective granuloma. It may invade many parts of the body, but usually finds its entrance into the human body by means of the digestive tract, the mouth—notably the tongue—being the point of direct infection. The cheek or a carious tooth may be the point of infection. It is only within the last fifteen years that it has been recognized as an inhabitant of human beings. Israel published the history of thirty-seven cases in 1885. The food, probably vegetable, is the source of infection. Direct infection may occur from handling diseased animals. The clinical history of a case during the formative stage simulates that of a malignant tumor. The point at which the fungus finds lodgement becomes the centre of a low grade of inflammation. New points of inflammatory thickening occur as the spores set free from the original point of infection diffuse themselves into the adjoining tissues. A swelling or tumor is thus developed by aggregation. The tongue becomes thick and hard. The so-called scirrhus, or wooden tongue, of the older writers may have been the result of this disease. The tendency of the disease if left undisturbed is toward continuous extension. It involves and destroys all tissues of whatever structure with which it comes in contact. A large tumor results, which may involve connective tissue and muscle. It invades contiguous structures. The tumor is more or less irregular in outline and of varying consistency. It is not specially painful, but may excite pain by pressure or by the inflammation which precedes suppuration.

A well-marked tumor is formed before suppuration occurs. Suppuration begins after softening has taken place and as the result of the

action of pyogenic bacteria. Other small foci of suppuration then develop in the dense fibrous tissue of the tumor. After the suppurative process is once fairly started the destructive ulceration may extend quite rapidly. The distress attending the involvement of the tongue will depend on the size of the tumor and the extent and position of the ulcerated points. Friction or raw points established on the tongue by injury may determine ulceration. Septic and pyæmic processes accompany the inflammatory destruction of the parts involved. The patient finally yields to exhaustion or to some intercurrent acute disease.

Diagnosis is made by demonstrating microscopically the existence of the fungus. The presence of small round sulphur-yellow or greenish-yellow bodies, varying in size from a minute speck to that of the head of a pin, are suggestive of actinomyces. These can be found in the pus and in the tissue affected.

Treatment.—Recent clinical observations prove that it is not essential to extirpate the entire mass of the diseased tissue. Extensive extirpations are not so urgently demanded as at first appeared. The conditions of the disease are to be met much as we should tubercular invasions of the tissue. Extirpation is to be clean and complete where possible. Incisions, curetting, and an open wound-surface which will permit thorough treatment will often yield good results where extirpation is not possible. Indeed, it is said that actinomycosis in isolated cases, when it produces suppuration and sloughing on free surfaces, tends to spontaneous recovery. Exposure to air is unfavorable to the propagation of the fungus. Suppuration, although it opens up new areas for the invasion of the specific growth, destroys many of the spores and the well-developed granules of the fungus by washing them out with the pus. This disease in the tongue, bathed as it is in the secretions of the mouth, flooded with the food, and subjected to the impure air of respiration, is formidable because of the constant danger of secondary infection of the lungs, not only with pyogenic organisms, but also with actinomyces. It demands specially clean and complete extirpation in order to obtain rapid healing of the parts. If the incision can be made so as to approximate the wound-surfaces, it should be done. This disease is specially dangerous in the tongue from the presence of a long-continued sloughing surface in the mouth. Excision is to be preferred, because it leaves a wound which quickly heals, though thorough curettement may cure actinomycosis of the tongue.

Patients after a partial extirpation of the tongue find that an irregular stump answers fairly well for the functions of ingestion of food and of cleansing the mouth, and they learn to talk with it. A thick, big, immovable tongue is more of an impediment to speech than its loss.

Tumors.—Dermoid tumors of the tongue are not very rare. Those situated to one side of the median line are placed between the mylo-hyoid and the genio-hyoglossal muscles. They find origin in errors in the union of the clefts formed by the branchial arches. These dermoid tumors appear in the floor of the mouth to one side of the tongue, and are soft, semi-elastic cysts; they are opaque and thick-walled, and are filled with semi-solid contents in which are found epithelium and possibly hair and the varied contents we find in dermoid cysts. They are not translucent, thin-walled cysts like the so-called ranula.

In the median line, running between the hyoid bone and the foramen cæcum at the base of the tongue, there is an obsolete canal, the remnant of a tubular outgrowth from the ventral wall of the embryonic pharynx. It is a fibrous cord, showing the position of the obliterated thyrolingual duct. This duct may not be obliterated throughout its entire length. It is usually open at the lingual extremity. A dermoid cyst may be developed in an unobliterated portion of this canal. If the portion below the hyoid forms a cyst, it develops a fistula in the median line below the hyoid bone. Most of the lingual dermoids develop from that portion of this duct which is above the hyoid bone. They are observed in young adults. In an inflamed dermoid of the thyrolingual duct in a young man aged twenty-one, who had for eighteen months noticed an enlargement under the tongue, an acute inflammation had been excited by electro-puncture, and when he came under my observation the cyst-wall and the surrounding tissues were thickened and infiltrated. Deglutition was difficult and respiration was much impeded. The tumor was sensitive and painful; it pushed the tongue upward and backward, so that it pressed against the palate. The tumor filled the floor of the mouth and pressed against the teeth, overlapping their margins. The swelling was very marked below the chin. It presented a full, rounded surface which fitted the outline of the lower jaw, pushing forward to the prominence of the chin. He had fever. The cyst was large and contained a semi-liquid mass extremely offensive in smell. These tumors of the thyrolingual duct are situated in the median line under the tongue, and are between the genio-hyoglossi muscles. These dermoids should be dissected out; the cyst-walls should be removed with the contents. If they are small, it may be done through the mouth, but if of considerable size, it is best to make an external incision and remove them by dissection from without, though the above case made good recovery with curetting and drainage. The cysts formed in the thyrolingual duct are not necessarily dermoids; simple cysts filled with serum may develop. Papillomatous cysts or villous growths may appear in connection with this duct, and these may develop malignant epitheliomas.

RANULA.—This term should be restricted to the dilatation of the ducts of the salivary glands. This was its earlier meaning, and if so restricted it derives something more than a topographical significance. The significance of the name may be still further modified by designating the cyst so as to indicate its origin as a submaxillary, a sublingual, or a parotid ranula. Those most frequently involved are the ducts of the sublingual glands, the ducts of Rivini. Wharton's duct is also not infrequently thus dilated. A narrowing of the orifice of the duct, an inflammatory obstruction of the calibre of the duct at any point in its course, or an impacted salivary calculus may be the cause of the dilatation and the resulting ranula. They are essentially retention-cysts, though a pathological cause outside of an obstructed duct may be instrumental in their origin. The fluid contained in the submaxillary and sublingual varieties contains mucin and is thick and tenacious.

These ranulæ form thin-walled, transparent cysts filled with thick glairy fluid. Generally they push upward from the floor of the mouth and fill the spaces under the anterior part of the tongue, being more prominent on one side than the other. They are rarely present in the

median line. Occasionally, when very large, they create an irregular, oblong swelling under the jaw, which may push downward into the tissues of the anterior part of the neck. The swelling is soft, nodular, and fluctuates. It can be pushed upward until it becomes quite prominent under the tongue. They are not very painful.

Cysts, not of the ducts, may originate in the salivary glands. Cysts of the submucous glands may form under the tongue, even as they do in the lip. The anterior lingual glands which are situated on either side of the median line near the tip of the tongue may dilate and form cysts. Blandin's gland and Nuhn's gland are of this group. The sublingual bursa of Fleischman, which is occasionally developed in the cellular tissue, may form a cyst. These are not properly classed as ranulæ.

Treatment.—The ranula is sometimes relieved by dilating the orifice of the obstructed duct, by removing a salivary calculus, or by the use of the seton to establish a new or more free channel for drainage of the gland. These simple methods fail at times to accomplish the purpose. A triangular flap may be cut from the wall of the cyst, and, after denuding the under surface of the flap of the cyst-wall, the point of the flap may be turned into the cavity of the cyst and fixed to the wall of the tumor at a denuded point. Frequently the cyst-wall is thick and firm, and the mucous membrane of the floor of the mouth may be removed, and the flap can then be turned out, doubled on itself, and secured by suture. A more radical procedure is frequently demanded. The cyst should be emptied of its contents through a free incision and the sac of the cyst dissected out. It may come away easily from its loose connective-tissue envelope, or it may be difficult or impossible to remove the entire sac. If the space left by such dissection is large or any considerable portion of the sac remains, the cavity should be stuffed with gauze and kept open for a time. The more perfect the removal of the sac, the more certain the cure. The wound usually heals kindly, but the prognosis for cure of the ranula is not always certain. The cysts of the mucous glands are best treated by excision.

ANGEIOMA of the tongue is not very frequent, and is generally venous in character. It is apt to be one-sided. The portion of the tongue affected is thickened, perhaps irregular in surface, soft, and compressible. It is usually congenital.

A case of nævus, or wine-mark, of the right side of the face in a young man recently came under observation. It was a very dark red, almost venous, in color. The dark discoloration not only involved the skin of the right side of the face, but also the mucous membrane of the cheek, the jaw, the palate, and also the right half of the tongue. It was limited, except on the lower lip and the alveolar margin of the lower jaw, by the median line. Here it encroached upon the left half, but in the palate the median line served as its limit, the uvula alone escaping its encroachment. The tongue showed the discoloration in its right half only, and there was also a marked thickening of the right half of the tongue, caused by an enlargement of the venous sinuses, giving this angeioma of the tongue a cavernous character. The tissue of the cheek, the palate, and the mucous surface of the alveolar margin were not materially increased in thickness. No discomfort was produced in this case.

It is sometimes difficult to diagnosticate the presence of a cavernous nævus in the tongue. The outline and the sensation to touch may be very like that produced by the local dilatation of the lymphatic vessels which occurs in lymphangeioma.

If treatment becomes necessary, the operation is likely to be a serious one. Excision is the most satisfactory method when it can be effected. Electrolysis may accomplish something. Ligature of the lingual arteries may effect a radical change for the better in the part; but neither electrolysis, setons, nor ligatures will here effect a radical cure. If excision of an angeiomatous tumor of the tongue is to be made, the lines of incision must be outside of the diseased tissue in order to make a safe and complete operation. It will not do to cut through the vascular tissue. Fortunately, it is very rare that vascular tumors of the tongue need excision. The extent of the tumor will, of course, determine the character of the operation. Its management will be better outlined when we consider extirpation of the tongue.

PAPILLARY GROWTHS of the tongue are formed by hypertrophy of the papillæ, and are hardened aggregations which constitute a warty growth. There may be many of them on the tongue. If but one appear, it is probably a cancerous wart or the beginning of an epithelioma. Occasionally one or more of the fungiform papillæ may hypertrophy and form soft tufts which project from the dorsum of the tongue. These growths, if well developed, and especially if single, should be excised. This is specially true of those which occur in patients past middle life.

A LIPOMA may occur in the tongue, as it does occasionally in other intermuscular tissue. It starts from the connective tissue, and is usually in the anterior part of the tongue. If of any size and troublesome, it may be easily excised.

FIBROMA.—Fibroids may occur, and be either imbedded in the tissue or pedunculated. They have no special characteristics, and treatment is determined by local indications.

LYMPHO-SARCOMA.—Along that segment of the tongue next the epiglottis, on the dorsum, there is a portion of lymph-tissue which furnishes the so-called tonsil of the tongue. The growth may become troublesome from its size or it may develop a lympho-sarcoma of the tongue. These round-celled sarcomas may be of long duration, but should be removed if they exhibit continued increase in size, as they may become markedly malignant.

ACCESSORY THYROID GLAND.—Near the base of the tongue, contiguous to or arising from the thyrolingual duct, there occasionally grows a tumor which resembles in its structure the thyroid gland. Butlin describes two cases of this kind where the protuberance developed by the growth was quite marked and distinct. The tumor was situated in front of the epiglottis and caused but little inconvenience.

EPITHELIOMA.—A nodule, a fissure, or a wart precedes the development of an epithelioma of the tongue. The nodule or fissure is frequently overlooked by negligent or non-observant patients, the first symptom noticed being the ulcer. The ulcer is apt to develop more promptly from the nodule or fissure than from the wart. The malignancy of the growth is also more manifest. The pathological changes

in the tissues of the tongue are much the same as those shown in other tissues. The progress of the disease in the tongue is, however, rapid, and often quickly fatal. The certainty of glandular involvement in epithelioma is well recognized, but in the tongue it is more rapid and decided than in other parts. The life-history of epithelioma of the tongue is generally from six months to three years, the great majority of cases finding their limit within two years. I have, however, the history of a well-marked case in a patient aged sixty-three years where it was over seven years from the history of the initial ulcer to the death of the patient, which occurred about three years after the extirpation of the tongue and enlarged lymphatics. Other cases with histories extending over three and four years show that the duration of the disease has no fixed limits. Surgeons report cases where the duration of epithelioma is prolonged, but there can be no question but that it is more rapid and fatal in the tongue than in many other locations, and its history is in marked contrast to that on the lip when the latter is so affected. It occurs most frequently between the forty-fifth and sixtieth years of life, but has been recognized in patients as early as the twenty-second year, and of course may be found in advanced life.

A large proportion of cases—variously estimated at from 65 to 85 per cent.—are males. This fact, in conjunction with the well-known fact that an epithelioma is most apt to develop at a point of friction, shows the influence of oft-repeated traumatisms or of continued inflammation in producing the disease. The smoker's patch, a leucoma or psoriasis of the tongue, predisposes to this malignant growth, but does not by any means always develop it. Smoking has, however, justly been given as one of the reasons why males are more predisposed to this disease than females. Here, as elsewhere in the body, cancerous disease is primarily local, and as such must receive prompt and efficient treatment. It is to be specially urged in disease of the tongue, because it here always takes the form of epithelioma. This, although it early involves the glands in diseased action, is rarely disseminated through the system by other channels, as are other forms of malignant diseases. It is a noteworthy fact that the glandular enlargement is often out of proportion to the original ulcer. The ulcer may be small, insignificant in appearance, and permanently relieved by excision, but the glandular infection is most apt to have occurred, and it is especially to be dreaded. The glandular involvement may be in the floor of the mouth, or under the anterior border of the sterno-mastoid muscle, or behind the ear under the mastoid. It may remain latent for a time. The glandular involvement is, Mr. Jonathan Hutchinson thinks, especially dangerous and difficult to manage when it involves the glands behind the mastoid in the back part of the neck. After the growth becomes active in these glands it is especially to be feared. It is unusual to find the glands in these several positions enlarged at the same time. The infection appears to expend its power in some one or more of these groups. The location of the ulcer on the tongue no doubt in part determines the group of glands to be involved. The ulcer at the base of the tongue and in the tonsillar region will more certainly involve the glands about the mastoid and along the carotid sheath, while an ulcer situated near the tip of the tongue will naturally invade the glands about the floor of the mouth.

These glandular masses, when large, soon escape the limitation of the capsule and invade all neighboring tissues. The serious or important part of an effort to extirpate an advanced case of epithelioma is found in dealing with the lymphatic glands and their surroundings.

A cancerous wart on the tongue does not so quickly ulcerate as the epithelioma, which has its beginning in the nodule or the fissure, and its malignancy is not so early manifested. The wart is the least malignant form of epithelioma of the tongue. Ulceration is, however, always present in the advanced disease, and often is the first condition noted indicating clearly the character of the disease.

The slow, systemic dissemination of cancer of the tongue, its limitation to contiguous structures and to glandular involvement, and the certainty of an early fatal result if left without operation, present conditions which justify the most thorough, radical, and persistent pursuit of the disease.

The surgeon should not lose sight of the fact that the tongue is not essential to deglutition, to speech, nor to taste. These functions are all impaired by its removal, but not as effectually as by its complete invasion by cancerous disease. Future work here should be done at a more favorable time than that which has given us our present rate of mortality and determined the frequent recurrence of the disease. The operation should be made earlier in the history of the disease, and at a time when extensive dissection of parts outside of the tongue is not demanded. The removal of a part or of the entire tongue is not difficult nor especially dangerous. Involvement of the entire tongue and of tissues outside of the tongue, combined with glandular involvement, demands serious consideration before operative measures are undertaken. Division of the lingual nerve for the relief of pain is sometimes advisable when removal of the growth is impossible.

Symptoms.—The ulcer is situated on the side, and usually in the anterior half, of the tongue. It is single, and presents a dirty, sloughing surface. It occurs in middle life and in the aged. Pain is usually present. It has an indurated base, and the margins are infiltrated or soon show a hardened area. The older the ulcer, the greater the induration. The advance of the infected parts invades all contiguous tissues, varying only in the rapidity of their destruction. The jawbone is very frequently involved. The infiltration and involvement of all tissues contiguous to the ulcer makes the tongue rigid and stiff, and adhesions bind it down, so that it becomes useless.

There can be no doubt of the **diagnosis** in advanced cancerous ulceration, but in the early stages, when doubt may exist, the absence of a syphilitic history or of distinct evidence of tertiary syphilis makes the ulcer a suspicious one.

All persistent ulcers of more than two months' standing, unless continued traumatism is evident, should be freely and completely excised. It is good treatment for a tubercular ulcer, and early extirpation offers the only possible hope in a cancerous ulcer. Constitutional treatment with the iodides should testify for or against syphilis and enable the surgeon to avoid an unnecessary operation.

The lymphatic glands are involved early, and, though often indistinct, they do not at first enlarge rapidly or escape their capsules. They

ultimately lose their outline and blend with contiguous tissues, so that they are hard to define when removal is attempted.

Prognosis.—The prognosis of epithelioma of the tongue is bad, much worse than when it is on the lip. The duration of the disease is short. Permanent relief, even by early and complete removal, is rare. Recurrence within a year is the rule, yet excision affords the only relief possible. All treatment, aside from extirpation by operation, should be palliative and symptomatic. It should be soothing, and not irritating. The early removal of the diseased tissue promises more or less perfect relief, permanent in a small percentage of cases. This percentage should materially improve with early diagnosis and radical and thorough operation.

Treatment.—*General Considerations.*—Excision of the cancerous ulcer is the treatment. The ulcer is most frequently situated on the anterior half of the tongue. A part of the tongue or the entire organ can be removed through the mouth with comparative safety if the tissues about the hyoid bone are soft, pliable, and normal. Clinical experience proves that partial excision is often effective against recurrence of the disease in the stump. Mr. Jonathan Hutchinson thinks it remarkable how often the secondary involvement of the glands and the freedom of the stump demonstrate the wisdom of the procedure. The disease ought to be recognized early and before complete extirpation, which is more dangerous, is demanded. The danger of operative relief necessarily varies with the magnitude of the operation. The statistics now accumulated are unreliable as a guide to our present work, for discrimination has not been thoroughly made between partial and complete extirpation, with and without the removal of the lymphatic glands. The history of epithelioma and modern operative experience show clearly that almost all operations made for removal of the tongue, whether complete or partial, represent unfinished surgical work unless lymphatic or submaxillary glands have been removed. The glandular involvement is almost certainly present in some of the groups of the lymphatics connected with the tongue. This is true when only a part of the tongue is involved and removed, and much more certainly is it necessary where the disease is so pronounced as to demand complete extirpation. Great difference in statistics must result also with different operators in complete extirpation, for where one surgeon has endeavored to make his operation radical and thorough by entire extirpation of the tongue, even where only a part of its tissue was involved, another has removed the whole tongue only when its tissue has been all diseased, and he has endeavored to secure thorough work by searching for and removing all involved glands. Operators must give more explicit details concerning the extent of disease and the character and extent of the operations performed for its relief before a uniform basis can be established for reliable statistical results. Partial removals have been made in the more favorable cases, and this does not, as a rule, imply added external incisions for removal of diseased lymphatics, though we are constrained to believe, from clinical results, that many of these cases must have shown at the time of operation glandular involvement. These are the hopeful cases for thorough and radical operation. The search for, and the removal of, diseased lymphatics must add to the danger of the operation, for they

imply an extension of the disease to other parts besides the tongue, as well as a more extended operation and the necessity of anæsthesia for a longer time.

Lymphatic glands are no doubt often infected when they are not large enough to be detected through the skin. The surgeon must expose the glands before he can feel assured that they are free from disease.

The duration of life in cancer of the tongue is thought to have been more than doubled through the operative measures which surgeons have practised. The mortality after complete extirpation is variously estimated at from 8 to 20 per cent. The recurrence of the disease after operations is frequent, and is estimated by some authorities to occur in from 80 to 90 per cent. of the cases. This recurrence is much more frequent in the glands than it is in the tongue, even after a partial extirpation. Notwithstanding these somewhat gloomy statistics, there can be no doubt that operative measures are of value in prolonging life and in relieving pain. Early operations are to be strongly recommended, and late removals, if justified by temporary recovery, relieve from painful deglutition, from a foul mouth, from persistent pain, and from the mental distress which accompanies this deplorable condition. All suspicious tissue must be removed if within the limits of safety. The tongue, the arch of the palate, the tonsils, a portion of the jawbone, together with diseased lymphatics, may in selected cases be legitimately removed.

Dangers of Excision.—The fatal results from excision of the tongue arise from hemorrhage, shock, exhaustion, pneumonia, septicæmia, and pyæmia. The danger from hemorrhage is to be feared, not only from the amount of blood which may be lost, but also from its entrance into the trachea. Excessive hemorrhage can be avoided by primary ligation of the lingual arteries through external incisions. It can also be controlled by traction on the tongue made by ligatures passed through its substance or by the finger hooked behind the epiglottis, pulling upward and forward the larynx. The frænum and the anterior arch of the palate should be divided early, so that traction on the tongue shall influence the position of the larynx. The lingual arteries may be secured either before or immediately after their division. The use of the écraseur or the galvano-caustic knife or wire also limits the amount of blood lost. The trachea can be protected from the entrance of blood by the position of the head and the attention of the assistants. If the operation is to be made through the mouth, the patient should be in a semi-sitting posture, with mouth held open with a gag and the head inclined forward.

The shock from operations upon the tongue is not necessarily great. Patients bear operations about the face well, but if the neck is invaded and extensive dissections are made to remove glands, the shock is greatly increased. These operations, however, are generally made on persons in advanced life. Every care should be taken to discover and guard against any systemic or special weakness. The simple administration of an anæsthetic is often dangerous to elderly people, and any operation, however trivial, adds to its danger. The exhaustion which not infrequently follows and is a part of the shock may develop heart failure or disturbance of nutrition or an arrest of the secretion of the kidneys that may quickly determine death.

Septic pneumonia may occur from the blood which enters the trachea or from the foul inhalations produced by the sloughing surface of the wound. Pneumonia may develop during the progress of the disease without operation from the exhalations and the purulent secretions of the cancerous mass.

Septicæmia is a danger which it is difficult to exclude, yet an aseptic wound can be maintained for several days, and usually until a granulation-surface is developed as a barrier to diffuse inflammation. Thorough cleansing of the mouth prior to the operation is essential to its avoidance.

Pyæmia is less likely to arise when the tissues have been cut than when they have been crushed. It may supervene in a small percentage of the cases with or without operative measures. The veins, in common with other tissues, inflame and ulcerate and open channels for pyæmic infection.

Selection of Special Operation.—The following propositions should be considered in the selection of the special operation to be performed in a given case of cancerous disease of the tongue:

(1) Infected glands should be sought for and removed in every case.

(2) Partial removal of the tongue through the mouth is justified when the disease is limited to one side of the organ or when only the anterior segment is involved. Partial removal is satisfactory, for recurrence takes place much more frequently in the glands than in the stump of the tongue.

(3) When complete extirpation of the tongue is required, the tissues at the base of the tongue and in the floor of the mouth will be involved to such an extent that glandular disease will demand external incision for their removal; hence it is best made through a submaxillary opening. Complete extirpation of the tongue through the mouth is readily made, but where the conditions demand so radical an operation, it is not wise to attempt a thorough removal of all diseased tissue without exposing the parts by an external incision.

(4) The galvanic knife or wire and the écraseur favor secondary hemorrhage and sepsis.

(5) Diseased glands should be sought for by external incision, even when the tongue is removed through the mouth, if there is the slightest local evidence of involvement.

Partial Removal.—Early recognition of the character of the disease is necessary in order that a partial removal of the tongue through the mouth may be effectual. This operation is best accomplished in the following manner: The patient is placed in the semi-sitting posture, with head inclined forward and held firmly in position by an assistant. Ether as an anæsthetic should be freely administered in the beginning, and sparingly during the latter part of the operation. The gag for holding the mouth open must be adjusted so as to keep the jaws widely separated. Two strong silk ligatures are to be passed through the tongue, one in the healthy tissue, and the other so as to command the portion to be removed. If the tip of the tongue is to be removed, the frænum must be divided with the scissors, as also should be the anterior arch of the palate if a portion of the base is diseased. The tongue is pulled well forward in the mouth by traction on the ligatures, and the

line of division between the healthy and the diseased tissue is made either with the knife or scissors. The diseased portion is then severed from its attachments to the floor of the mouth. This is not difficult, for the tissues at the base of the tongue are still mobile and can be lifted well up toward the opening of the mouth. The lingual artery may be caught before its division when the tissues are thus made tense, or if severed can usually be secured without great trouble. Strong traction on the ligatures which pass through the tongue, or pulling the tongue and hyoid bone upward and forward by means of the finger hooked behind the epiglottis, prevents free hemorrhage. The blood which is necessarily lost flows forward out through the mouth, while the larynx is guarded by position against the influx of blood.

Complete Extirpation.—Complete removal of the tongue should be made by external incision. This should usually be just below the border of the jaw through the tissues of the submaxillary triangle. The operation which best fulfils the anatomical and the pathological conditions without undue mutilation is the following: The patient is placed in the recumbent position. The anæsthetic having been administered, the mouth should be held moderately open with a gag and the tongue transfixed with a ligature. The head is turned to one side, and a curved incision one and a half inches long just above the hyoid bone is made for the ligature of the lingual artery. If diseased glands are present on both sides, it may be necessary to prolong this incision for their removal. The head is now turned so that the side of the tongue most completely invaded is uppermost. A curved incision is made from a point behind the angle of the jaw to its symphysis. The lower part of the curve is at the hyoid bone. The lingual artery is secured and the diseased glands removed. The mouth is then opened by cutting through the floor near the jawbone. The opening should be made in the anterior portion of the submaxillary triangle, and enlarged as freely as is necessary to obtain easy access to the diseased tissue. The head should now be so placed as to have the mouth on a lower level than the back of the head, so that any blood oozing from the wound may run forward. The tongue is put upon the stretch, and its attachments are severed with the scissors, so that all of the tissues of the floor of the mouth which are diseased can be removed. Division of the jawbone is not necessary for simple removal of the tongue, and it is not justifiable unless it is diseased and is in part to be removed, except involvement of the arch of the palate and the tonsillar region may warrant its division. The external wounds are closed, except at a point for the insertion of drainage-tubes. This operation gives clean-cut surfaces for healing. It enables the surgeon more certainly and satisfactorily to determine the line of tissue to be severed than can be done by écraseur or by any operation through the mouth. It gives access to diseased glands, and provides easy and perfect drainage through the tube placed in the floor of the mouth and carried out through the incision in the neck. Hemorrhage is controlled, and there is a minimum of danger of blood running into the larynx. It is impossible for the patient to cleanse his mouth after the removal of the tongue. The drainage-tube enables him to wash it thoroughly. There is less danger of the epiglottis and its attached tissue turning back over the trachea than in partial removal of the tongue.

It is well to know the different methods of operation for complete removal of the tongue.

Heath's Method.—"Removal of the entire tongue may be most satisfactorily performed by dividing the lower jaw, so as to allow of the application of the galvanic écraseur close to the hyoid bone. An incision in the median line of the lower lip, prolonged to the hyoid bone will allow of the dissection of the lip from the jaw for about a quarter of an inch on each side. With a drill the bone can then be perforated on each side of the median line, and about midway in the depth of the jaw, so as to admit of the two halves being subsequently drawn together with wire. The jaw is then to be divided exactly in the median line with a fine saw, which may advantageously have its handle above the level of the blade, so as to be out of the way of the patient's chest. The section need not be completed with the saw, but the bone-forceps may be used for the purpose, the slight irregularity often resulting being advantageous in maintaining the parts in apposition. The halves of the bone should be held asunder with hooks while the operator cuts the genio-hyoglossi muscles from the jaw with a pair of scissors, leaving the attachment of the genio-hyoid muscles. With the fore finger and scissors the tongue can then be dissected from the floor of the mouth with the sublingual glands and the mucous membrane, until the hyoid bone is reached, firm traction being made with a stout string passed through the tip. The tongue being drawn down, the palato-glossi muscles will be put on the stretch, and must be divided with the scissors, after which a handled needle should be passed through the tongue close to the hyoid bone, around which the galvanic wire should be passed. The battery should not be too powerful in its action, and the screw of the écraseur should be worked very slowly or hemorrhage may occur, and it would be difficult to arrest, since both the lingual arteries are probably divided at the same time.

"The operator should be prepared with a handled needle and stout thread to transfix and hold the small remnant of tissue left attached to the hyoid bone should breathing be embarrassed by the epiglottis and base of the tongue falling back. In the author's experience this is much more likely to happen when a considerable portion of the tongue is left than when the section is made far back, and the difficulty seems to arise from the weight of the piece left forcing back the epiglottis when the sublingual muscles have been divided.

"All the hemorrhage having been checked, the two halves of the jaw are to be brought together with a piece of stout silver wire. This may be passed from before backward readily enough through the hole in one side of the jaw, but it is not easy to pass it back again on the opposite side unless a loop of this wire be passed from before backward through the hole already made, into which the end of the wire can be bent and thus drawn forward. The two halves of the jaw should be brought into close and correct apposition, and the ends of the wire twisted and brought up beneath the lip; the lip is then to be brought together with hare-lip pins and a fine silk stitch in the mucous membrane; but care should be taken to leave the lower part of the incision open, so that there can be a free drain for the saliva and discharge from the mouth.

"In removing the wire from the jaw at the end of three weeks or

more it will be found convenient to cut the wire close to the jaw on each side, and then with a blunt hook pull out the loop from behind."

Morant Baker removes the tongue through the mouth in two separate sections. Two ligatures are placed, one in each half of the tongue. The tongue is divided to its base, and each half separately removed by putting the écraseur about it.

Whitehead's Method.—The patient is to be placed in a semi-sitting posture, with head inclined forward and with a gag holding the mouth wide open. Two ligatures are placed in the tongue. The tongue is pulled forward, and the scissors are used to divide freely the frænum, the anterior pillars of the fauces, and the attachments to the floor of the mouth. Whitehead disregards oozing from the cut surfaces; bleeding from a vessel is controlled by torsion or ligature. He thinks the lingual arteries can usually be caught in forceps before they are divided. A ligature should be put through the glosso-epiglottidean fold before the tongue is finally separated and removed. There is no fear of hemorrhage after the lingual arteries are secured. The scissors are used to complete the excision.

Hutchinson pulls forward the tongue, frees it from the floor of the mouth, and then transfixes it with curved needles, which are passed behind the diseased tissues. The wire loop of an écraseur is now carried about the tongue behind the curved needles. The screw of the écraseur is tightened slowly and the tissue severed behind the needles.

Nunneley passes a loop of the écraseur up through the floor of the mouth through a puncture made with a strong, heavy needle at a point in the median line midway between the chin and the hyoid bone. The loop is then spread so as to envelop the tongue and pass behind the needles, which are placed as before described in Hutchinson's plan. These operations for the removal of the tongue usually make an incomplete operation, for a small portion of the base of the organ is left.

Regnoli, *Billroth*, and *Kocher* devised and used submental operations. Regnoli made a curved incision under the chin with its centre at the symphysis and its two arms extending back to the angle of the jaw. A vertical incision extending from the middle of this incision backward along the median line divided the flap into two parts. These flaps, when dissected loose from the jaw and turned back, gave free access to the tongue, which was removed by the écraseur or the knife. Billroth omitted the vertical incision of Regnoli, and made one arm of the curved incision longer than the other. The lingual arteries were tied, the mouth opened, and free access was thus gained to the tissues in the floor of the mouth. Kocher makes a more formidable operation of the removal of the tongue, in the hope that he may attain asepsis and protect the lungs from any invasion of blood, pus, or exhalation from the wound. Preliminary tracheotomy is first performed. An incision is carried from the tip of the ear to the symphysis of the jaw. It passes downward along the anterior border of the sterno-mastoid muscle to the level of the hyoid bone, forward along this bone and the anterior belly of the digastric to the symphysis. The flap is turned up, the lingual artery ligated, and if necessary the facial. The lymphatics and salivary glands are removed if diseased. The opposite lingual artery is tied

through a separate incision. A sponge with a string attached is placed in the pharynx to prevent fluids from passing into the larynx and to cut off communication between the lungs and the mouth. The mucous membrane of the mouth and the subjacent tissue on the side of the long incision having been divided, the tongue is pulled through this opening and removed by the scissors or galvano-cautery. Kocher prefers the galvano-caustic knife. The wound is to be closed or not as may be determined at the time, and it is dressed antiseptically. The dressing should be changed twice a day until it has healed. The patient is fed by a stomach-tube.

Asepsis of the wound is practically maintained until a granulated surface is formed, in a great majority of the cases, by thorough cleansing and proper care, without tracheotomy. Vomiting may at any time infect the field of operation after or during Kocher's operation, even as it does in the other methods, in spite of the tracheotomy.

Sédillot advises an incision through the lower lip and section of the bone at the symphysis for the purpose of removing the tongue. Division of the maxilla, it appears to me, is an unnecessary procedure, unless the arch of the palate and tonsil is to be removed or the bone itself is diseased and needs incision.

After-treatment of Operations on the Tongue.—The wound should be kept clean. The surface may be packed with iodoform gauze moistened in compound tincture of benzoin. This will usually hold its place for two or three days. On the second or third day, or whenever the gauze becomes loose, it should be removed and the parts thoroughly cleansed and repacked. Weir recommends that gauze be impregnated with a mixture of iodoform, 5 parts; resin, 10 parts; castor oil, 6 parts; and alcohol, 15 parts. Friar's balsam or the comp. tinct. of benzoin, made with a saturated ethereal solution of iodoform, to which 1 part in 10 of turpentine has been added, is commended by Mr. Whitehead. The drainage-tube which has been left in the external incision helps materially to keep the surface inside the mouth clean. The mouth should be thoroughly irrigated with hot salt solution each time it is dressed.

Most of these operations are made upon old men, and the nutrition of the patient is very important. It will not do to omit nourishment for two or three days, as we do after many important operations in younger subjects. The patient should be fed through an œsophageal tube and by nutrient injections into the rectum. A plentiful supply of fluids is needed.

The patient should be encouraged to sit up and move about the room as early and as much as is consistent with his strength.

The nerves of the tongue are of importance in a surgical way, not alone because we need occasionally to divide the lingual nerve for pain, but because of their connection with nerves finding a remote distribution in other parts. They may indicate the origin and the situation of local inflammatory processes. The glosso-pharyngeal supplies the root of the tongue, the soft palate, the pharynx, the Eustachian tube, and the tympanum. Hence pain in the root of the tongue may be associated with disturbance in the ear, the pharynx, or the palate. The reverse would of course also be true. It supplies also the posterior third of the

tongue with the sense of taste, and probably the pillars of the fauces and the pharynx.

The gustatory nerve, which conveys not only the sensory fibres, but also the filaments of the special sense of taste to the anterior part of the tongue, has also extensive association with other parts through its connection with the trigeminus and chorda tympani. It is thus associated with the sensation of the skin of the face and head, except in the occipital region and the posterior surface of the ear and the tip of its lobe. The chorda tympani supplies the anterior two-thirds of the tongue with fibres of the special sense of taste. These fibres, being with the sensory fibres of the gustatory branch of the inferior maxillary division of the fifth, are occasionally divided for the relief of pain in the tongue. This nerve is readily found near the inner surface of the angle of the jaw. It can be picked up by a small hook just inside of the entrance of the inferior dental nerve into the inferior maxilla. A very good way to locate the nerve is to pull the tongue forward and to the opposite side. The tension on the nerve makes it prominent. A ridge of mucous membrane outlines its position. An incision in the line with the ridge should expose it and it can then be pulled forward and a portion excised.

Dr. E. C. Runge examined the records and obtained the facts from which the following statistical tables were arranged.

The histories of the cases utilized for these statistics were imperfect. The only items gleaned from the reports of many were the nature of the disease and the fact of death or recovery.

The deductions made from some of the tables must be accepted as suggestive, not as positive truths, for the facts necessary to an exact and definite appreciation of the individual cases and the details of the operations were not always stated:

TABLE No. 1.—*Results of Operations for Partial or Total Removal of the Tongue in 583 Cases recorded during a period extending from 1860 to 1894.*

	No. of Cases.	Deaths.	Recoveries.
Partial excision with glands	102	26, or 25.5 %	76, or 74.5 %
" " without "	180	18, " 10 %	162, " 90 %
Total " with "	106	21, " 19.81%	85, " 80.19%
" " without "	195	34, " 17.44%	161, " 82.56%
Totals	583	99, or 16.98%	484, or 83.02%
Total operations with glands	208	47, or 22.6 %	161, or 77.4 %
" " without "	375	52, " 13.87%	323, " 86.13%
Totals	583	99, or 16.98%	484, or 83.02%

TABLE No. 2.—*Cases not included in Table No. 1, excepting 3 Cases.*

	No. of Cases.	Deaths.	Recoveries.
Cases reported by E. Bottini (in 1894) of lingual epithelioma operated upon with the thermo-cautery, in the course of the past twenty-five years.	100	7, or 7%	93, or 93% 3 of these cases in Table No. 1.
Cases reported by T. Billroth of carcinoma linguæ operated upon from 1871 to 1876.	42	18,[1] or 42.86%	24, or 57.14%

TABLE No. 3.

Total number of cases	583 See Table No. 1 97 " " " 2 42 " " " 2	722
" " " deaths	99 " " " 1 7 " " " 2 15 " " " 2	121,[2] or 16.76%
" " " recoveries	484 " " " 1 90 " " " 2 27 " " " 2	601, " 83.24%

TABLE No. 4.

The condition operated for.	No. of cases.
Epithelioma	716
Sarcoma	2
Tuberculosis	1
Macroglossia	1
Syphilis or epithelioma	1
Tuberculoiss or epithelioma	1
Total	722[3]

TABLE No. 5.

In the following cases the operation involved the removal of other parts besides tongue and glands (as sublingual tissue, portions of alveoli, lower jaw, hyoid bone, pharynx, lips, fauces, velum palati, submaxillary

[1] Death in 3 cases due to some intercurrent disease.
" 15 " " " the operation.

[2] The three cases of death noted in Table 2 as due to some intercurrent disease appear here as recoveries from the operation.

[3] In 722 cases 99.17 per cent. were epithelioma.

salivary glands, tonsils, epiglottis, ligation of external carotid and jugular, past operative laryngotomy):

	No. of cases.	Deaths.	Recoveries.
Partial excision with glands	30	7	23
" " without "	11	1	10
Total " with "	30	9	21
" " without "	12	1	11
Totals	83	18, or 21.69%	65, or 78.31%

TABLE NO. 6.—*Showing recurrence. Total number of operations without glands, 375.*

	Recurrence noted.	No recurrence noted.	Death after operation.	Total cases to be observed.
Partial excision, glands found enlarged, but not removed	6	20	1	19
Total " " " " " "	5	34	9	25
Partial excision, glands found apparently normal	7	47	3	44
Total " " " " "	5	47	10	37
Partial " " not mentioned in the reports	4	98	13	85
Total " " " " " "	10	92	15[1]	77
	37	338	51	287

TABLE NO. 7.—*Distribution of Recurrence according to the Extent of the Operation.*

	No. of cases.	Per cent.
External excision	33	56.2
Buccal "	25	43.1
Modus operandi not specified	11	
Total recurrences	69	

Kocher is inclined to think that non-recurrence stands in direct relation to the gravity and extent of the surgical procedure.

[1] Macroglossia.

TABLE No. 8.—*Deaths through Recurrence, stating the Time of Recurrence after Operation.*

Partial excision.		Total excision.	
With glands.	Without glands.	With glands.	Without glands.
5 months.	1½ months.	2 months.	3½ months.
6 "	4 "	2½ "	4½ "
7 "	6 "	6 "	5 "
8 "	17 "	8 "	5½ "
8 "	24 "	9 "	7 "
12 "	24 "	10 "	8 "
24 "	1 case not specified	12 "	9 "
24 "		12 "	12 "
24 "		14 "	12 "
4[1] cases not specified		36 "	12 "
		2 cases not specified	13 "
			14 "
			18 "
			60[2] "
			1 case not specified.
13 cases.	7 cases.	12 cases.	15 cases.

No. of cases.		Per cent.
25	Operations with glands	53.19
22	" without glands	46.81
47	Total	100.

TABLE No. 9.—*Cases of Recurrence still Alive at the Time of the Report.*

Partial excision with glands	3
" " without "	9[3]
Total " with "	4[4]
" " without "	6[5]
Death from recurrence as per Table 9	47
Total cases of recurrence	69

TABLE No. 10.

Total No. of Cases.	Recurrence noted.	Death from other causes.	Bal. without recurrence at time of report.	Per cent. of recurrence.	Per cent. no recurrence.
583	69	99	415	14.26	85.74

[1] One case noted glandular recurrence.
[2] Glandular and local recurrence.
[3] In 6 cases glandular recurrence noted.
[4] " 1 case " " "
[5] " 2 cases " " "

TABLE No. 11.—*Causes of Death.*

Syncope	3 cases.	Intestinal hemorrhage	1 case.
Cyanosis and dyspnœa	1 "	Pyæmia	11 "
Hemorrhage[1]	4 "	Septicæmia	6 "
Asphyxia[2]	4 "	Erysipelas	2 "
Asthenia	12 "	Purulent bronchitis	1 "
Shock[3]	1 "	" broncho-pneumonia	2 "
Œdema glottidis	1 "	Septic pneumonia	5 "
Diphtheria	1 "	Pulmonary gangrene	3 "
Acute miliary tuberculosis	1 "	" abscess	1 "
Cachexia	3 "	Pneumonia and pleuro-pneumonia,	12 "
Pulmonary tuberculosis	1 "	Broncho-pneumonia	6 "
" embolism	1 "	Pleurisy and gastro-enteritis	1 "
" hemorrhage	1 "	Pleurisy and neck-abscess	1 "
" œdema	4 "	Unknown causes	6 "
" emphysema and other complications	1 "	Total	99 cases.
Hypostatic pneumonia	2 "		

In 51 cases death resulted from an acute infection following in the wake of the operation—*i. e.* 52.04 per cent.; and in 42 cases it was due to some pulmonary trouble—*i. e.* 42.86 per cent.

TABLE No. 12.—*Distribution of the 51 cases[4] of Death by Acute Post-operative Infection, according to the period of the occurrence of the operation.*

	Before 1880.	After 1880.
Pyæmia	8	3
Septicæmia	4	2
Erysipelas	1	1
Purulent broncho-pneumonia	1	1
Septic pneumonia	. .	5
Purulent bronchitis	1	
Pulmonary gangrene	. .	3
" abscess	. .	1
Pneumonia and pleuro-pneumonia	6	6
Pleurisy and gastro-enteritis	. .	1
" " neck-abscess	. .	1
Broncho-pneumonia	2	4
Total	23	28
Total number of cases = 51	45.1 %	54.9 %

Assuming that antiseptic and aseptic measures have been more efficiently enforced since 1880, they do not appear to have materially influenced the mortality.

[1] In 1 case the galvanic écraseur was used by the mouth.
In 1 case the wire écraseur was used by the mouth.
In 1 case the wire écraseur was used by the mouth after ligation of lingual arteries at their origin (Shrady's).
In 1 case the operation was submental.

[2] In 1 case the asphyxia was brought on by a piece of sponge lodged in the larynx.

[3] The procedure was Whitehead's—scissors by the mouth.

[4] This includes the cases of so-called "Schluckpneumonia" (deglutition pneumonia).

TABLE No. 13.—*Distribution of Death according to the Instrument used at the Operation.*

	Partial excision.	Total excision.	Total.	Deaths.	Per cent.
Knife or scissors	112	111	223	30	13.45
Thermo-cautery[1]	53	24	77	14	18.18
Ecraseur[2]	34	83	117	21	17.95
Not specified	83	83	166	34	
Total	282	301	583	99	

TABLE No. 14.

	Cases.		Cases.
Billroth (1877–85)	38	Tunis, J. P.	1
Kocher	50	Newman, F. H.	1
V. Langenbeck	21	Minter, H.	1
Durham	13	Vandeveer,	1
Lucas	10	Raddick	2
Symonds	8	Fenwick, G. F.	3
Davies-Colley	7	Moore, W.	2
Golding-Bird	2	May, B.	1
Jacobson	13	Marshall, A.	3
Bryant	7	Elder, G.	1
Howse	2	Page, F.	2
Whitehead	16	Purcell, F. A.	6
Baker, W. M.	44	Stephens, L.	1
Alexander, Wm.	16	Rivington	2
Treves, F.	5	Berkeley Hill	3
Barker, A.	5	Page, H.	1
Butlin	48	Frank, K.	1
Erichsen	8	Wood	2
Buchanan, G.	7	Barwell, R.	2
Lund	3	Lane, W. A.	2
Hughes	1	Canton	1
Bartlett	1	Jordan, F.	1
Jolly	1	Gamgee	1
Jones	1	Syme, G.	1
Lediard	1	Gont	1
Bradley	2	Spence	2
Ewart	1	Reid	2
Heath, Ch.	7	Shrady, G. F.	1
Spanton, W. S.	3	Lange	1
Harrison, R.	1	Bull, Wm. T.	2
Holmes, T.	1	Meyer	1
Fearnley, Wm.	1	Weir, R. F.	1
Annandale, Thos.	2	Stimson, L. A.	2
Lunn, J. R.	3	Paget	4
Lockwood	1	Nunneley, Th.	2
Cleghorn, J.	5	Haywood	1
Ross	1	McGill, A. F.	4
McLeod, K.	4	Bromwell, J. P.	1
White, J. A.	1	Grant, F. W.	1
MacCormac, A.	1	Macleod, H. B.	1
MacGilliway, P. H.	4	Bernays, A. C.	3
Toland	1	Southam	1
McLean, R. A.	2	Gross, S. D.	1
Coyley	3	Stokes	2

[1] This includes the galvano-cautery and the galvano-écraseur.
[2] This includes the wire and cord écraseur.

	Cases.		Cases.
Croly, H. G.	3	Dambrowski	1
Howe, J. W.	2	Pacher	1
Derry, G.	1	Podrazki	3
Homars, J.	1	Czerny	1
Warren	2	Kummer, E.	1
Beach, H. A.	1	Villeneuve	1
Morris	1	Desprès, M.	3
Lydston, G. F.	2	Duret	2
Parker, R.	1	Alsberg	1
Fergusson	1	Herazel, E.	1
Nottingham	1	Wieden	1
McBurney	1	Ricchi, T.	1
Coates, W. M.	1	Valerani, T.	1
Morton, Ch. A.	1	Toca, M. de	1
Kelly, J. E.	1	Mazzoni	1
Sheperd	4	Ballanghien, A.	1
Smith, F. C.	2	Bérenger-Féraud	1
Tobin, R. F.	1	Baeckel, E.	1
Walker, G. E.	1	Dudon, M.	1
Lane, L. E.	1	Fauern, V.	1
Duncan, G. M.	1	Dernucé, M. P.	1
Fitzgerald, T. N.	1	Hicquet	1
Clark, O, H. E.	1	Gulli, P.	1
Beaney	1	Boni, D.	1
Abbe, R.	1	Menzel, A.	2
Carmalt, W. H.	2	San Pablo, S. de	1
Holmes, B.	1	Marcacci, J.	1
MacNamara	1	Piccini, R.	1
Spencer	1	Pereira-Guimarães	1
Thomson, Wm.	2	Paci	1
O'Grady, E. S.	1	Perucci, D.	2
Richardson, B. W.	1	Berns, A. W. C.	1
Levis, R. T.	1	Tauber, A. S.	1
Field, Ch. M.	1	Klifasoffsky, N. V.	3
Cunniff, W.	1	Vela, J. G.	1
Dawson	1	Lershin, L. L.	1
Brown, G.	1	Bottini, E.	[1]3
Aikins	1	Luigi Cesare	1
Bark, J.	1	D'Ambrosio, A.	2
Bell, H. R.	2	Vincentiis, C. de	2
Hearn, W. J.	1	Bertini, L.	2
McNaughton, Jones	1	Creus, D. F.	1
Weinlechner	7	Galozzi	1
Helmuth	1	Landi	3
Girard, D.	1	Gozzini-Paccioni	1
Fiaschi, Th.	2	Mecad	4
Walt, B.	2		
Albert, E.	2	Total	583
Verneuil	1		

[1] These 3 cases are included in the 100 cases reported by him. (See Table No. 2.)

DISEASES OF THE SALIVARY GLANDS.

By CHARLES B. PORTER, M. D.

THE parotid gland is in relation with and contiguous to such important structures that a knowledge of its surgical anatomy is necessary for the proper performance of operations for the relief of the various diseases to which it is subject. The following is a translation from Tillaux :

The parotid gland is an irregular mass of tissue occupying the region below and in front of the ear, and extending deeply inward under the ramus of the jaw to the lateral wall of the pharynx. Its important relations are best understood by bounding the walls of the cavities which it fills.

For purposes of description this cavity may be considered to be roughly triangular on horizontal section, oblong on vertical section. *Posteriorly*, from without inward, are found the sterno-mastoid muscle, posterior digastric belly, styloid process with its muscles, the internal jugular vein, internal carotid artery, the great nerves, and at the apex the pharyngeal wall ; *anteriorly*, the masseter, ramus of jaw, internal pterygoid, and again the pharynx ; *superiorly*, the cartilage of the external auditory meatus, posterior portion of the glenoid cavity, base of the skull ; *inferiorly*, strong fascia from the angle of the jaw to the sterno-mastoid muscle, and a line therefrom upward and inward to the pharynx ; *externally*, the skin, subcutaneous tissue, with the platysma and risorius muscles.

On the face the parotid gland extends upward to the inferior border of the zygoma, anteriorly to a variable extent over the masseter muscle, inferiorly to the before-mentioned line from the angle to the sterno-mastoid muscle, which with the mastoid process and the external meatus forms its posterior boundary.

On all sides the gland is covered by its proper fascia, a part of the cervical fascia, which, starting from the sterno-mastoid fascia, covers the gland and is inserted above into the zygoma. In front it merges with the masseteric fascia ; below it is attached to the ramus of the jaw and stylo-maxillary ligament.

This parotid fascia is well defined, firm, and internally adherent to the underlying gland-tissue, into which it sends numerous strong septa. The deeper portion of the fascia covers the numerous structures mentioned above, closely adherent to the base of the styloid process and the periosteum of the skull.

Not only does the gland fill the above cavity, but it sends out a number of processes, the most important of which passes in front of the styloid process to the pharynx ; others may extend between the two

pterygoids, between the sterno-mastoid and digastric, while the glenoid cavity is regularly occupied by the "glenoid lobe." Passing through the gland are a number of structures.

The facial nerve, leaving the stylo-mastoid foramen, runs obliquely downward, forward, and a little outward, deep in the gland-substance. Passing external to the artery and vein, the nerve divides at the posterior part of the ramus into the temporo-facial, which makes for the external orbital angle, and the cervico-facial, turning downward and inward. The pes anserinus is formed in the substance of the gland.

The auriculo-temporal nerve pierces the upper part of the gland from within outward, and then emerges at its superior boundary. The external carotid artery penetrates the gland at its antero-interior angle, at the junction of the middle and lower fourths, passing thence obliquely upward, outward, and backward to the neck of the jaw, where it divides into the temporal and internal maxillary. In its course through the gland the posterior auricular is given off.

The superficial temporal and internal maxillary veins unite just below the level of the neck of the jaw to form the temporo-maxillary trunk, which runs external and a little anterior to the artery; emerging at the posterior inferior angle of the gland, it is continued as the external jugular.

In the substance of the parotid gland are a number of lymph-glands which drain the eyelids, eyebrows, and skin over the malar bone. One gland, in particular, is almost constant just in front of the tragus. A set of glands runs along the anterior edge of the sterno-mastoid in the gland-substance. These are often involved in tubercular cervical adenitis.

Stenson's duct arises on a line from the tragus to a point midway between the ala of the nose and the red margin of the lip. It commences on the posterior surface of the gland near its anterior part, being overlapped by the gland for almost three-quarters of an inch. Soon after leaving the gland it is often joined by a branch from the socia parotidis; it then crosses the masseter, turns inward about its anterior border, pierces the buccinator, runs obliquely beneath the mucous membrane, and empties finally into the mouth opposite the crown of the second upper molar tooth. The duct is about two and a half inches long, of an average diameter of one-eighth of an inch, though at its termination it will barely admit a fine probe.

The following surgical points are important:

I. The course of the facial nerve.

II. The relation of the deep lobe to the pharynx and great vessels and nerves.

III. The external carotid artery and temporo-maxillary vein.

IV. The irregular outlying processes, rendering complete extirpation difficult.

V. The course of the duct.

VI. The dense fascia, covering it with numerous septa.

Diseases of the Parotid Gland.

The diseases of the parotid gland which call for surgical interference are tumors of the gland, salivary calculus, salivary fistula, parotitis, and

abscess. The tumors are sarcoma, carcinoma, adenoma, fibroma, and cystoma. This gland is remarkable, however, for the complex character of the tumors which originate in it. Structurally they exhibit extraordinary variety. Sutton says:[1] "It is not unusual in sections from a parotid sarcoma to meet with spindle-cells, cartilage, myxomatous tissue, glandular acini in an area 2 cm. square." Tumors of such complex variety grow rapidly, attain a large size, and tend to infiltrate the surrounding tissues and skin, to invade the lymphatics, and cause secondary deposits in the lungs.

The enchondromata of the parotid are of two varieties, one of which consists entirely of hyaline cartilage. It grows with excessive slowness, and may require a number of years to grow to the size of an olive. This variety is benign, and complete removal ensures against its return. The second variety is that in which the cartilaginous tissue predominates, but is combined with other tissue, connective tissue, mucous tissue, with adenoma or sarcoma; and according to the extent that these other elements enter into the growth it assumes a malignant character. The mixed tumor grows more rapidly, is more difficult of thorough removal, and the prognosis is more grave.

Sarcoma of the parotid is more common than carcinoma, and next to the latter in malignancy. It is seen more frequently in middle life, while carcinoma belongs to advanced years, except the soft variety, which shows itself in the young. Sarcoma grows rapidly by insinuating itself in and among the surrounding parts, as well as by infiltration. It grows deep into the neck behind the ear, inward behind the pharynx, acquires attachments to the carotid sheath, and interferes with circulation and deglutition. Rapidly-growing ones involve the skin, which ulcerates. Without operation the growth may extend inward and press upon the pharynx, and result in fatal dysphagia, or downward, producing pressure upon the deeper structures of the neck, and by ulceration open the large vessels and cause fatal hemorrhage, or by emboli invade the lungs and form secondary nodules. After operation there is a strong tendency to local recurrence. This is due to its proneness to infiltrate the surrounding tissues, which renders complete removal a matter of difficulty.

Carcinoma of the parotid is much more rare than was once thought, before it was differentiated from sarcoma and other growths by the microscope. It belongs to the late period of life, is of slow growth at first, but in the later stages its history is quite similar to that of sarcoma, except that it produces secondary infection through the lymphatics, while sarcoma does so through the veins. Its treatment is by extirpation.

Adenoma, or "glandular tumor of the parotid," occurs usually in patients between fifteen and thirty years of age, is painless, has a distinct capsule, and may appear in any part of the gland. It is usually small and easily shelled out of the parotid. If the tumor attains a large size, it is movable and loosely connected. Its surface is knotted and irregular in outline, hard and firm in places, elastic or fluctuant from the presence of cysts.

The fibroma, myxoma, and cysts of the parotid are usually associated

[1] Sutton, *Tumors Innocent and Malignant*, p. 91.

with other growths. This is not the case with hydatid cysts, a few cases of which have been reported.

Prudden[1] has described a case of rhabdo-myoma of the parotid. The tumor contained, in addition to round- and spindle-cells, numerous spindles and tubules lined with cubical epithelium.

As to the excision of tumors of the parotid, it may be said that in many cases the operation may be done with great ease; in others, with the greatest difficulty. The mobility of the growth, the character of its attachment, the extent to which it has grown into and among the surrounding parts, the age and condition of the patient, the possibility of removing the whole growth, the presence of secondary infection, must influence the surgeon in his decision. Tumors here, as elsewhere, should be removed for the temporary relief afforded. Size is no contraindication. A large tumor which does not involve the deeper parts of the gland tends by its weight to draw them from behind and beneath the jaw, and removal is thereby made easier than in case of the normal gland. Removal of a tumor which demands extirpation of the whole gland must always be a formidable operation, and requires an accurate knowledge of anatomy and the skill of an experienced surgeon. Facial paralysis must be recognized as a probable sequel to this operation. This tends to improvement in time, and might in some cases be remedied by suture of the divided ends of the facial nerve. Some writers have questioned the possibility of total extirpation of the parotid gland. This was first accomplished in this country by Dr. Warren of Boston in 1798. Since that time so many cases have been reported by surgeons whose veracity, knowledge, and skill are unquestioned that the operation must be recognized as feasible.

It may well be doubted if total extirpation of the parotid for large tumors will be necessary as many times in the next century as in the last, because of the more general diffusion among the people of the knowledge that in all cases of tumors or swellings the advice of the physician should be sought; the appreciation among physicians of the fact that with tumors delay may be dangerous; and the greater facilities for obtaining surgical aid.

Parotitis (epidemic), or mumps, is an infectious disease which produces inflammation of the parotid gland. It is usually unilateral, but the other side may become affected in a few days. Occasionally it is bilateral from the beginning. There is a tendency to metastasis to the testicles in the male and to the breasts and ovaries in the female. It is of no surgical importance, except it result in abscesses, which should be treated by incision, antiseptic cleansing, and drainage. The incision of the skin should be free, but that of the gland only sufficient to ensure drainage, for fear of salivary fistula.

Parotitis secondary, metastatic parotitis, parotid bubo, may be a complication of any serious acute disease, as typhoid fever, typhus fever, pyæmia, pneumonia, or in connection with injury or disease of the abdomen, pelvis, or genitals. It is a serious complication, and in most cases it is undoubtedly of septic origin. Its treatment is that of any phlegmonous inflammation—in the early days the application of leeches and ice. If these do not reduce the inflammation and promote resolu-

[1] *Amer. Journ. Med. Sciences*, 1883.

tion, hot fomentations must be substituted. As soon as fluctuation is detected the abscess must be treated as in abscess following mumps.

There is another form of suppurative parotitis—the diffuse—in which many or all of the lobes of the gland are involved. This is attended from its onset with severe pain, due to the tension of the firm, fibrous investment of the gland and its lobes. Free multiple incision must be made through skin and fascia parallel with the course of the nerve and Stenson's duct. Each fluctuating focus as it develops must be opened.

Operation for the Removal of the Diseased Parotid Gland.—The diagnosis and the decision to attempt removal of the tumor only or of the whole gland should be controlled by the microscope at the time of operation, when possible. As a preliminary step a ligature should be passed around the common carotid artery, to be tightened during the operation if necessary. This I have done a number of times in operations upon the neck—simply lifting on the ligature controls hemorrhage temporarily while the bleeding points are secured—and removed the ligature at the completion of the operation. The shoulders should be elevated and the head turned to the opposite side. A curved incision is made from a point midway between the mastoid process and the condyle of the jaw downward, parallel with the ramus, around the angle and forward nearly to the anterior border of the masseter, and upward to the junction of the zygoma with the malar bone. The flap of integument thus marked out should be lifted from the subjacent parts to a level with the zygoma and turned over the side of the face. Where the tumor is large an additional incision, made vertically downward from the angle of the jaw, may be necessary. There is much to be gained and nothing lost by a generous incision of the skin.

The lower and posterior part of the tumor should be first attacked, lifted by dissection from its bed, and pulled upward. This will expose the external carotid as it passes through this gland; this should be tied and divided. The facial nerve enters the gland at the posterior margin and divides in the gland into two great branches, the temporo-facial and the cervico-facial. Although it may well be considered an impossibility to save the nerve intact, its position and relation may be borne in mind and all filaments saved as long as possible, in hopes that by suturing them after the removal of the tumor total paralysis of that side of the face may be prevented. The deeper lobes of the gland, which penetrate between the mastoid process and ramus of the jaw into the sphenoid cavity and between the external and internal pterygoid muscles, are best enucleated with the blunt dissector, remembering that they rest upon the internal carotid artery and jugular vein, injury to which is the source of the greatest danger in this operation. Holding the jaw as far forward as possible and turned to the opposite side opens up to the best advantage the narrow space between the jaw and the mastoid process. The divided end of the distal portion of Stenson's duct should be ligatured and rendered aseptic by the cautery or strong carbolic acid, to prevent infection of the wound through the mouth.

Complete control of all bleeding points having been obtained, the wound should be closed with sutures, with drainage at the most dependent part. A large compressing and compressible dressing should be

applied, so as to afford accurate approximation to the wound. At the present time it is almost superfluous to add that the field of operation, the hands of surgeon and assistants, instruments and dressings, must be surgically clean.

In connection with the subject of treatment of malignant growths reference may be made to the theory of their micro-parasitic origin, and I quote the concluding paragraph of an article by Shattuck and Ballance[1]: "The great merit of the micro-parasitic theory has lain and lies in this, that it not only offers a working hypothesis for further investigation with which none other can compare, but it holds out the hope that cancer may one day admit of a scientific treatment based on the same lines as that of the micro-parasitic diseases."

The treatment of malignant growths by inoculation of erysipelas or the injection of the products of erysipelas is the subject of investigation by many scientific men. William B. Coley,[2] in a paper on the "Curative Treatment of Sarcoma and Carcinoma by Erysipelas," has collected up to date of his paper all the cases cured by the accidental intercurrence of erysipelas or by the inoculation of it or its toxic products, and his conclusions are as follows:

"*Conclusions.*—1. The curative effect of erysipelas upon malignant tumors is an established fact. 2. The action upon sarcoma is more powerful than upon carcinoma. 3. The treatment of inoperable malignant tumors by repeated inoculations of erysipelas is both practicable and not attended with great risk. 4. The curative action is systemic as well as local, and probably due chiefly to the toxic products of the streptococcus, which products may be isolated and used without producing erysipelas. 5. *This method should not be employed indiscriminately* until further experiments have proved its limitations."

I refer to the bibliography at the end of Dr. Coley's paper those who wish to study the results of various experiments in this field of research.

Salivary Fistula.

Salivary fistula is the condition in which the normal secretion of the gland escapes through an abnormal opening on the side of the face or neck. It results from a wound which severs the duct, or from abscess, ulceration, or gangrene. In many cases salivary fistulæ close by the ordinary process of healing, while in others they are more obstinate and difficult to cure. After the removal of tumors and tuberculous glands on the upper part of the neck I have had a number of times a slight weeping of saliva from the wound, due to a trifling injury to the gland. These have always healed in a few days. If a case where the duct has been injured is seen soon after the injury, the best treatment is to pass a small silver probe or wire through the opening of the duct in the mouth along the distal portion of the duct, and through the two cut ends into the proximal portion of the duct, and unite the cut ends around the probe with very fine catgut sutures (the sutures should not enter the lumen of the duct), and close the rest of the face-wound in the usual

[1] "Micro-parasitic Origin of Cancer," Shattuck and Ballance, *St. Thomas's Hospital Reports*, vol. xx. p. 236.

[2] *Reference Handbook of Med. Sciences* (Supplement), p. 784.

manner. Catgut should be used for the suture of the duct, because silk would so readily become infected from the mouth along the duct, and produce suppuration before it could be absorbed.

Sometimes the fistula persists because the artificial opening is the easier exit for the saliva. In such a case re-freshing the edges of the opening and suturing it tightly compels the saliva to seek its natural channel. The seton has been used with success. A stout thread, soaked in balsam of Peru or well waxed, is passed through the fistula into the mouth, the end brought out at the angle of the mouth, and the two ends tied together on the cheek. When the opening in the mouth has been established the edges of the external opening should be re-freshed and the resulting wound closed by sutures.

Another method, ascribed to Horner, is with a large, sharp punch to make an opening, including the fistula, directly through the cheek into the mouth, and immediately close the wound of the integument. Each and all methods fail in some cases.

The Submaxillary Gland.

Anatomy.—The submaxillary gland is intermediate in size between the parotid and the sublingual. It is situated below the body and inner surface of the inferior maxilla, in the triangle formed by the two bellies of the digastric muscle. It is covered by the skin and platysma myoides, and rests on the mylo-hyoid, hypoglossus, and stylo-glossus muscles. The facial artery passes above and behind it on its way to the face. This is the only vessel of size which would be wounded in the removal of the gland for disease. The duct of the submaxillary gland, called Wharton's duct, about two inches in length, passes round the posterior border of the mylo-hyoid muscle, runs forward and inward upon that muscle and beneath the sublingual gland to reach the side of the frænum linguæ, where it opens. Its blood-supply is from the facial and lingual arteries.

Diseases of the submaxillary gland are, in the order of their frequency, cysts, enchondroma, sarcoma, and carcinoma. The duct and its radicals are the seat of calculous concretions. In making a differential diagnosis the characteristics of the growth, the duration of the disease, and the age of the patient must be considered.

Cysts are usually of slow growth and belong more especially to young adult life. The tumor is rounded, smooth in outline, elastic, and fluctuant.

Sarcoma is more elastic than carcinoma; there is absence of pain, with little tendency to ulceration. There is no adhesion or discoloration of the overlying skin, while in carcinoma there is marked hardness, a knotted irregularity of outline, immobility, with tendency to adhesion and ulceration, associated often with great pain. Carcinoma rapidly invades the surrounding parts, the lymphatics are early invaded, and the disease proceeds rapidly to a fatal termination.

Enchondroma is the hardest variety of submaxillary tumor, is irregular in outline, slow of growth, painless, and produces discoloration of the skin and ulceration only from its size.

Calculus of the duct presents a hard, rather elongated mass in the

floor of the mouth, and can be felt by pressure with one hand under the jaw and finger-pressure in the mouth when in Wharton's duct; but these are sometimes formed in the radicals of the duct, in the gland, and then give rise to suppuration which demands evacuation. In abscess of the gland a concretion should always be sought for as the probable cause.

A calculus may give rise to no serious or troublesome symptoms for a long time, and then produce inflammation of the duct or gland, attended with great pain, tenderness, and a discharge of pus into the mouth. I have recently removed one from Wharton's duct from a patient forty-four years of age, who had known of its presence for twenty-two years. It had given rise to no inconvenience until the last two years. It was easily pushed out through an incision over the distal end, and measured one and a quarter inches in length and one and a quarter in circumference.

CYST.—See Cysts, Ranula, under Sublingual Gland.

ENCHONDROMA.—The tumor should be removed with as little mutilation of the gland-tissues as possible. These tumors rarely return if thoroughly removed. There is some danger of a resulting salivary fistula from wounding the gland, though such usually close in time.

SARCOMA and CARCINOMA of the gland demand its removal.

Removal of the Submaxillary Gland.—The patient should be placed upon a table, the shoulders raised, the head turned to the side opposite the one affected. A curved incision is made from the median line below the chin to the angle of the jaw, the lowest point of the incision being at the level of the hyoid bone; the skin, platysma myoides, and deep fascia are divided in this line. The lowest border of the gland is then sought, and its attachments by connective tissue to the hyoid bone, the skin, platysma myoides, and deep fascia divided in this line. The lowest border of the gland is then sought, and its attachments by connective tissue to the hyoid bone and digastric tendon divided with the finger and blunt dissector. It can then be easily separated from the mylo-hyoid and hyoglossus muscle, dragged upward over the jaw, and its deeper parts severed. Care should be used not to injure the hypoglossal nerve, which lies between the gland and the hyoglossus muscle. The facial artery must be divided and ligatured wherever it presents itself during the operation. The treatment of the severed end of the duct should be the same as that of Stenson's duct in the removal of the parotid gland.

SUBLINGUAL GLAND.

Anatomy.—The sublingual is the smallest of the salivary glands, and is situated in the floor of the mouth under the anterior part of the tongue, and when the latter is protruded forward and upward forms a ridge between it and the gums of the lower jaw. It is covered only by mucous membrane. It reaches from the frænum linguæ, where it is in contact with its fellow of the opposite side, obliquely backward and outward for rather more than an inch and a half. It rests on the genio-hyoglossus and mylo-hyoid muscles, the latter of which separates it from the submaxillary gland. It is in close contact with Wharton's duct and the lingual nerve. The lobes are not so closely bound together

as those of the parotid and submaxillary, and the ducts from many of them open separately into the mouth along the ridge which marks the position of the gland. These are named the ducts of Rivini, and are from ten to twenty in number. Some of them open into the duct of Wharton. One longer than the rest runs along the Whartonian duct, opens into or near it, and is named the duct of Bartholin. The blood-supply is from the sublingual and submental arteries, and the nerves from the lingual branch of the fifth pair.

DISEASES OF THE SUBLINGUAL GLAND.—*Cysts or Ranula.*—The orifices of the excretory ducts of the sublingual and submaxillary glands open into the mouth beneath the tongue. They are liable to obstruction from inflammatory changes or mechanical pressure, producing a retention of the secretion, followed by distention of the duct. The formation of the tumor is more or less rapid, depending upon the amount and character of the obstruction. It is soft and fluctuant to the touch, rarely painful, producing discomfort mostly from its size and the impairment of speech. It is semi-transparent, and ranine veins may frequently be seen ramifying on its surface. Any thickening of the cyst-wall from inflammation obliterates its semi-transparency. If left untreated, it may attain such size as to displace the tongue, embarrass articulation, and present a swelling under the chin, when due to distention of the ducts of Rivini, or at the side of the neck under the lower maxilla when implicating the ducts of Wharton. The contents of these cysts are usually ropy in character, clear but tenacious, like the white of egg. Agnew records one in which the fluid resembled a mixture of corn-meal and lymph; Richardson, one in which the fluid contained rice-bodies. It would seem a question to me whether the former was not a dermoid cyst, one of whose favorite habitats is under the tongue, and the latter, of Richardson, a synovial bursa, the subject of tuberculosis.

In Holmes's *System of Surgery*, vol. ii. p. 271, reference is made to two cases reported by Labbe[1] of hydatid cysts which simulated ranula. One of these was Gosselin's. The cyst-wall was much thicker than in ranula, and the diagnosis was made after the operation by the microscope.

Treatment.—Three methods present themselves for consideration—partial excision of the sac, the seton, and the injection of irritant fluids. They are all uncertain in results, especially the two first. With partial excision of the sac there is occasionally contraction of the opening and reclosure, necessitating a repetition of the operation. This, however, is by far the simplest and most effectual. In the seton and injection methods no efficient means are used to re-establish the opening into the mouth, and this is the principal cause of failure. In both there is opportunity for septic infection without adequate drainage.

In the operation by partial excision the mouth is held open by a gag, the most prominent part of the tumor seized with toothed forceps, and a considerable part of the anterior portion of the sac is cut away with a pair of curved scissors. When the sac is emptied of its contents, it should be swabbed clean and its cavity painted with tincture of iodine or a strong solution of carbolic acid or rubbed over with a stick of nitrate of silver. A cleansing mouth-wash should be used for a number of days.

[1] *Leçon de Clinique chirurgical*, par Leon Labbe, Leçon xxx., Paris, 1876.

Seton.—The tumor should be made prominent and a curved needle, carrying a silk thread, passed through the sac and the ends tied. This should remain for a number of days, until a sufficient inflammation is excited to cause obliteration of the cyst, when it should be removed.

Injection.—This consists in evacuation of the contents by aspiration or puncture and the introduction of tincture of iodine, the amount to be determined by the size of the cyst. These cysts sometimes rupture spontaneously and form a diffused swelling in the intermuscular spaces.

The form of ranula which has been considered is chronic, and usually has existed for a long time before surgical relief is sought; but Tillaux[1] describes a form which he calls *grenouilette aiguë*—acute ranula. He mentions having seen a number of cases, of which the following is a type: A man goes to bed feeling very well, falls asleep, and rouses abruptly in the middle of the night with a tumor the size of a hen's egg occupying the whole floor of the mouth, pressing the tongue slowly upward and backward, producing the physiological discomforts peculiar to that malady. One makes a puncture, and there flows out a considerable quantity of liquid, ordinarily slimy, stringy, and a little yellowish. How can one explain this? What is the seat, the point of departure, of this acute ranula? He further says that this dilatation is instantaneous and cannot be confounded with œdema or infiltration of the floor of the mouth—that this is a tumor, limited, circumscribed, encysted at the first onset, which collapses and empties itself completely as soon as it is opened, the cavity of which one can explore with the finger or an instrument. Acute ranula, then, has its seat in the sublingual mucous bursa.

FIG. 36.

Sublingual mucous bursa, called Fleischman's, seen upon an antero-posterior section of the floor of the mouth: *A*, cavity of the sublingual mucous bursa; *B*, its anterior or mucous wall; *C*, its posterior or muscular wall; *D*, the dotted line indicating the depth of the bursa; *E*, the duct of Wharton; *F*, the sublingual gland; *G*, the genio-glossus muscle.

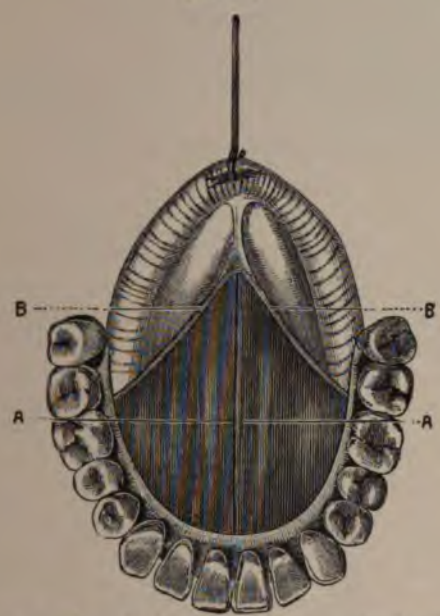
Our knowledge is not complete upon the pathogeny of acute ranula. Tillaux[2] concludes as follows: "Whence does the liquid come? Does it come from a rupture of the duct of Wharton, from rupture of some of the ducts of the sublingual gland, or rather is it the result of an acute hydrops of the sublingual bursa, having no other connection with the salivary glands than that of neighborhood? It is that which remains to be found out."[3]

The sublingual bursa, or bursa of Fleischmann, is subject to acute enlargement, simulating ranula. Fleischmann says: "If from one or the other side of the frænum one separates the mucous membrane from the tongue, one finds close to the frænum, resting on the genioglossus

[1] *Anatomie topographique*, p. 325. [2] *Ibid.*, p. 326. [3] *Ibid.*, p. 321.

muscle, behind the duct of Wharton and the ducts of Rivini, a small mucous bursa, oval-shaped, divided into cavities by cellular partitions—

FIG. 37.



Sublingual mucous bursa seen from the front after one has previously raised the anterior or mucous wall: *A*, *A*, interspace between the two genioglossus muscles; *B*, *B*, borders of the mucous bursa.

the sublingual bursa, the existence of which it is important to be acquainted with for a knowledge of ranula." This bursa is lined throughout with a distinct epithelium. Laterally it extends as far as the second molar tooth.

There are mucous glands in this region, and one of variable size, known as Nuhn's gland, near the tip of the tongue. Any of these may dilate, simulating a ranula. Such are best treated by dissecting out the whole cyst.

Primary carcinoma of the sublingual gland is an exceedingly rare disease. Gross[1] reports two cases. Both terminated fatally by secondary infection, having run a rapid course. This gland is invaded secondarily in cancer of the lip, mouth, or tongue.

CALCULUS.—See Submaxillary Gland.

[1] *Surgery*, vol. ii. p. 535.

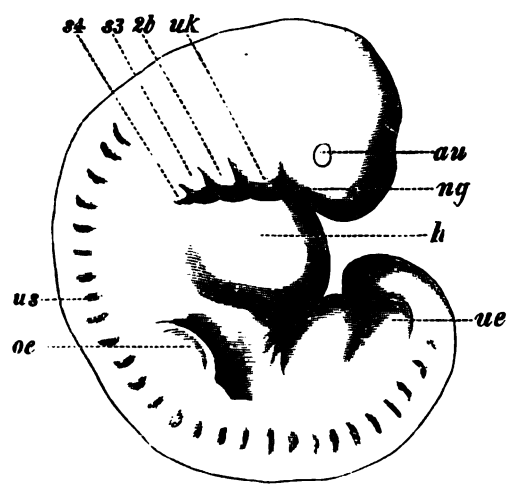
SURGERY OF THE NECK.

BY WILLARD PARKER, M.D.

DEVELOPMENT OF THE NECK.

AT the beginning of the third week of fœtal life four pouches form on each side of the primitive pharynx. Between these pouches, called branchial clefts, ridges develop, and in time these ridges, called branchial arches, join at their anterior extremities. In this way it comes that the pharynx has elevations and depressions arranged more or less circularly around it (Fig. 38).

FIG. 38.



Very young human embryo: *au*, eyes; *ng*, nasal groove; *uk*, lower jaw; *sb*, hyoid arch; *S3*, *S4*, third and fourth branchial arches.

As the ridges grow and protrude, depressions form on their external surfaces corresponding to the depressions internally. Externally the ridges and depressions are covered by ectoderma; internally, by entoderma. At the bottom of the depressions or branchial clefts there is only a double lamella, consisting internally of entoderma; externally, of ectoderma. Normally, these depressions or branchial clefts do not break through, and thus do not allow communication between an internal branchial cleft and a corresponding external branchial cleft.

The first branchial arch is sometimes called the mandibular arch, and forms the lower jaw. It lies above the first branchial cleft. *The second*

branchial arch, called also the hyoid arch, lies between the first and second clefts. *The third branchial arch*, also known as the thyro-hyoid, lies between the second and third clefts. *The fourth branchial arch* lies above the fourth cleft.

The first branchial arch unites in the median line with the fellow of the opposite side in front, and forms the inferior maxilla. Then from its upper border on each side, behind and near the origin of the arch, a maxillary process begins to grow. This, joining with its fellow in the median line in front, forms the superior maxilla. At the same time a frontal process comes down from above between the anterior ends of the maxillary processes (this frontal process later is the intermaxillary process), forming, where the maxillary process meets the frontal process, the lachrymal canal. Arrested development of the maxillary or frontal process will cause any one of the various forms of hare-lip.

The First Branchial Cleft.—This develops into the ear, the external cleft forming all that part of the ear external to the membrana tympani, the internal cleft forming that part internal to the membrana tympani, including the Eustachian tube. In front, on the inner surface of the ventral bow of the first (internal) cleft, the future tongue develops, taking its origin at the tuberculum impar. *The second branchial arch* is joined in front in the future hyoid bone, in forming which the anterior extremities of the third branchial arches also unite. These anterior extremities of the second and third arches help also to form the tongue (Fig. 40).

The Second Branchial Cleft.—The internal part of this cleft develops later into the fossa of Rosenmüller and the supratonsillar fossa above the tonsil, helping also to form the tonsil itself. The external part of this cleft (separated from the internal cleft by the double lamella of entoderma and ectoderma) contributes to the formation of the embryonic structure called the "sinus cervicalis," which is below described. *The third branchial arches* join in front, and, together with the second pair of arches, form the hyoid bone anteriorly, their conjoined ends entering also into the formation of the base of the tongue, as described below.

The Third Branchial Cleft.—The external cleft enters into the formation of the embryonic structure called the "fundus præcervicalis," described below, which is supposed to contribute to the formation of the thymus gland, supplying its concentric corpuscles, called sometimes the "corpuscles of Hassell." The internal cleft gives origin to the carotid and thymus glands. Between the anterior extremities of *the fourth branchial arches* the larynx develops, the latter being connected with the bud expanding downward from the lower end of the pharynx, where it communicates freely with the œsophagus, and dividing into two more buds at its lower end, which subsequently become the lungs (Fig. 40). The fourth arches are supposed to form the thyroid cartilages.

The Fourth Branchial Cleft.—The external cleft is unimportant. The internal forms the (embryonic) pouch called the fundus branchialis, which contributes to the formation of the thyroid gland. The fundus branchialis is a horizontal pouch lying in front of and external to the embryonic larynx. In adult life the internal cleft corresponds to the sinus pyriformis, or the space just external to the aryteno-epiglottic folds, on either side.

The first branchial cleft, external and internal, forms, as has been

said, the external and internal ear. Any abnormality in development may lead to a fistula or tumor—generally a fistula—situated in the vicinity of the external auditory meatus, usually about a half inch in front of it.

The Second Branchial Cleft.—The first and second branchial arches grow more rapidly than the third and fourth, and, soon overlapping

FIG. 39.

II, second branchial arch overlapping by its anterior border the third arch. At *Sp* a portion of the cleft still unclosed is visible; *Hw*, the surface of the neck, which has united with the third arch, the latter having pushed the fourth arch far inward; *Ip*, infundibulum præcervicale, at an earlier stage being the entrance to the sinus, the bottom of which is closed off; 3 and 4, third and fourth pharyngeal clefts; *th*, primitive thymus; *IX*, ganglion of glossopharyngeal nerve; *XII*, hypoglossal nerve; *nl*, superior laryngeal nerve; *Ep*, epiglottis.

them, form a space lined with ectoderma, which extends upward and backward, forming what is known as the sinus cervicalis, corresponding to the second external cleft. This sinus terminates (opens) near the future hyoid bone, and should be obliterated in the formation and development of that bone. If not, a tumor or fistula will result, terminating near the upper border of the hyoid.

The internal cleft makes the region about the tonsil, the anterior pillar of the fauces being the anterior or upper edge of the second branchial arch, the lateral glosso-epiglottic folds being the posterior or lower edge of the third branchial arch.

The Third Branchial Cleft.—The second and third arches grow over the fourth, forming a cavity the fundus præcervicalis (entered by the infundibulum præcervicale). This fundus præcervicalis, corresponding to the third external cleft, pushes inward until it lies very close to the third internal cleft. The ectodermal or epithelial elements are supposed to form the corpuscles of Hassell, the concentric corpuscles found in the thymus gland.

Abnormality in development may lead to fistulæ or to dermoid tumors found connected with the thymus gland, or in the anterior mediastinum, into which, in its subsequent development, the thymus gland descends.

The third internal cleft pushes down and out from the pharynx, so as to lie close to the third external cleft; it forms at its lower end, from the entodermal tissue lining it, the thymus gland, being subsequently

obliterated in all but its lower part, where the thymus is formed. Abnormality in development may lead to a (blind internal) fistula or tumor in the line of this cleft.

The fourth branchial cleft, externally, is of no significance. Internally it develops into a pouch called the fundus branchialis (embryonic), which is supposed to join with the lingual duct in the formation of the thyroid gland, described below.

The fourth internal cleft in the adult is represented by the space external to the aryteno-epiglottic folds on each side, and this space in the adult is called the sinus pyriformis. Abnormality of development in the fourth internal cleft may cause fistulæ or tumors in the neighborhood of the larynx, or tumors involving the thyroid gland.

The Meso-branchial Space of His.—The second or hyoid arch, having become complete anteriorly in the middle, leaves the third and fourth arches incomplete on each side. From the lower border of the hyoid arch a process is given off on either side behind and near the origin of the arch. These processes are called the "opercular processes." They join the lateral cervical wall over the incomplete third arch, the latter in turn overlapping the fourth arch. The opercular processes are roughly triangular, with the base on the lower border of the hyoid bone. Being a part of the hyoid arch, they help to form the sinus cervicalis (formed by the growth of the first and second arches over the third and fourth), forming on each side the external wall of that sinus.

As the opercular processes grow, their bases meet in the lower border of the hyoid or second arch, while their apices join respectively the later cervical walls and the anterior wall of the thorax. Thus a triangular space is formed with the anterior cervical wall below and on either side, the opercular processes meeting above in the hyoid or second arch. Beneath the opercular processes lie the anterior (as yet unjoined) ends of the third and fourth branchial arches. This "meso-branchial space of His" is closed by the growth upward of the anterior cervical wall, and the growth inward, toward each other, of the opercular processes of the hyoid or second arch, together with the completion of the third and fourth arches.

Abnormality in the growth or development of any one of these structures around the meso-branchial space will lead to a fistula or tumor. Furthermore, the growth of the opercular processes serves to obliterate the cervical sinus, which, like a pocket, extends around the anterior half of the primitive neck under the hyoid or second branchial arch. If one or other of the opercular processes fail to develop, the part of the cervical sinus which it overlaps will persist as a fistula or tumor.

Lingual Duct and Thyroid Gland.

In the anterior part of the bow of the first internal branchial cleft a knob, called the tuberculum impar, begins to form as the primitive tongue. Below this the anterior extremities of the (hitherto incomplete) second and third arches unite with each other across the primitive neck, and grow up against the tuberculum impar from below. Their junction with the latter is indicated in the adult by the line of circumvallate papillæ at the back of the tongue: their line of junction is in the

form of a V, at the apex of which, where the tuberculum impar and the conjoined extremities of the second and third arches meet, there is found the foramen cæcum—in the adult found in the apical circumvallate papilla. From this foramen cæcum a duct, the lingual or thyro-glossal, sprouts downward to form the thyroid gland.

In its growth this duct unites with a part of the fourth internal branchial cleft. This part is known as the fundus branchialis, and enters into the formation of the thyroid gland.

Abnormality in the development of this duct may lead to the formation of accessory thyroid glands, to a fistula (blind internal) opening into the foramen cæcum (at the back of the adult tongue), or it may produce a tumor in the floor of the mouth, sometimes mistaken for a ranula, but having no connection with the salivary ducts.

FIG. 40.

Floor of the oro-pharyngeal cavity: *Uk*, lower jaw; *II, III, IV*, second, third, and fourth bronchial arches; *T*, tuberculum impar; *Zw*, root of the tongue, and below it (*F*) the entrance to the larynx.

LARYNX, TRACHEA, LUNGS, AND BRONCHI.

By the junction of the anterior extremities of the fourth pair of branchial arches the thyroid cartilage is probably formed. On their inner surface, at their point of junction, an eminence arises with a median furrow, communicating freely with the œsophagus. This eminence and furrow, forming a pouch, branch downward and develop into the larynx, trachea, bronchi, and lungs (Fig. 40). Abnormal development here may cause a tracheocele or blind internal fistula of the trachea or respiratory tract.

The hyoid or second branchial arch, with its opercular process on either side, forms in the adult all the superficial portion of the neck known as the anterior cervical triangle.

At the time of their formation each pair of branchial arches is supplied with an axial nerve and artery. The arteries partly disappear in the process of development, but the nerves persist, and are in the adult the guide to the branchial arches in which they were originally contained.

First branchial arch supplied by trigeminal inf. dental,
Second " " " " facial, chorda tympani,
Third " " " " glosso-pharyngeal,
Fourth " " " " superior laryngeal.

Normally, all the branchial clefts should be closed by the second month of fœtal life.

BRANCHIAL FISTULÆ.

1. *Lateral cervical fistulæ*, placed on one or other side of median line.

2. *Median cervical fistulæ*, often communicating with trachea.

I. Lateral cervical fistulæ { complete, / incomplete.

1. Complete: with the inner opening in the pharynx, corresponding to the second branchial cleft around the tonsil. The outer opening

varies, corresponding with the fourth branchial cleft near the sterno-clavicular articulation, or near the inner or outer border of the sterno-mastoid muscle, near the larynx, and corresponding to the second and third clefts.

2. Incomplete: (*a*) Have an external opening (only) in these same regions, and in addition sometimes appear about 1 cm. above and in front of the tragus of the ear. These are remnants of the first branchial cleft. (*b*) The internal opening of an incomplete branchial fistula is usually in the lower part of the pharynx, and under this heading come the œsophageal (congenital) diverticulæ. The fistula may also open in the region of the tonsil.

II. Median cervical fistulæ { complete, incomplete.

1. Complete: external opening in median line of neck; internal opening into trachea, sometimes into the pharynx, above the larynx.

2. Incomplete: Open in median line, and generally extend up a variable distance. There may be incomplete internal fistulæ, communicating with trachea (tracheocele), congenital in origin.

Diagnosis.—External opening median or lateral (often having above it a cartilaginous or bony body which lies under the skin and is more or less movable), discharging a greater or less amount of mucus-like fluid, and, if complete, particles of food and saliva.

Incomplete internal fistulæ of the pharynx or œsophagus cause the usual dysphagia, regurgitation, etc. if œsophageal diverticulæ; or distention with air if they arise from the trachea, or with food if from the pharynx or œsophagus.

Treatment.—(*a*) Cauterization; tr. iodine; acid. carbolic., 95 per cent.; actual cautery. (*b*) Excision. If complete this may be very difficult or even impossible. Often the fistula is very near to important structures.

Incomplete external fistulæ are often best treated by laying open the whole length and excising the secreting membrane which lines them: this must be thoroughly done, or a sinus will result; all lining mucous membrane must be excised or destroyed.

Congenital (Branchiogenic) Tumors.

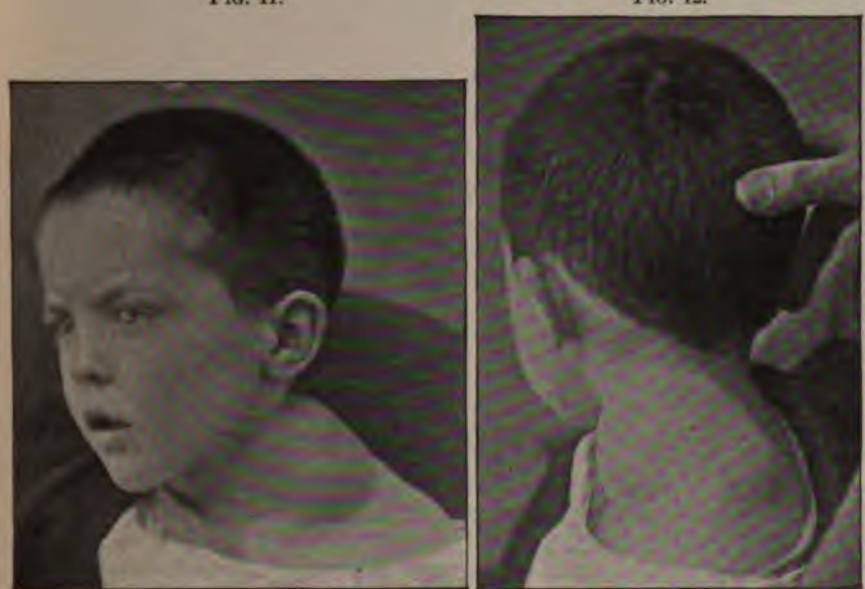
Synonyms.—Serous cysts; Hydrocele colli; Dermoid cysts.

Cystic in character; uni- or multilocular, located in the region of the original branchial clefts, usually in the region of the hyoid bone, between it and the mastoid process, at the anterior border of the sterno-mastoid muscle, and in the supraclavicular region. Those in the region of the hyoid bone may pass into the floor of the mouth, simulating ranulæ, but they have no connection with the submaxillary or sublingual ducts. If these latter are dermoid in character, they are formed at the time that the primitive tongue (tuberculum impar) takes its origin in the space between the inner surface of the ventral ends of the first and second branchial arches. The tuberculum impar is then covered anteriorly in the space between the arches by only the double lamina consisting of the ectoderma and the entoderma. The entoderm, ectoderm, and tuberculum impar adhere abnormally, and some ectoderma is drawn in as the tuber-

culum grows into the tongue. The ectoderma may later develop into a dermoid tumor under the tongue or in the floor of the mouth, or may be found even deep in the tissues of the neck: it arises from an error in development of the external branchial clefts, which are lined with ectodermal or epithelial tissues.

Dermoids found in the anterior mediastinum are probably to be referred to the third external branchial cleft where it adjoins so closely

FIG. 41. FIG. 42.



Branchial cyst.

the third internal cleft, from which the thymus gland is developed, the tumors being carried into the mediastinum by the sinking into this region, in the course of its development, of the thymus gland. It is probable also that some of these cysts are formed from the fundus branchialis, that portion of the fourth internal cleft entering into the formation of the thyroid gland, as some dermoids in this situation are connected with the thyroid.

The contents may be serous, mucous, atheromatous, or any combination of these, depending on the extent of the mucous or fatty degeneration taking place in the epithelial cells; exceptionally, they may contain blood from traumatism, ulceration of some vessels in the walls of the cyst, or, if the walls be very vascular, from capillary exudation. The secondary changes occurring in these tumors are—suppuration, carcinomatous degeneration.

Primary carcinoma has been observed between the muscles of the neck, not connected with the skin, pharynx, lymphatic or salivary glands, and this kind of carcinoma is ascribed to epithelial remains of branchial clefts. The capsules are made up of fibrous tissue, more or less vascular; occasionally they are composed of adenoid tissue. The

lining epithelium is usually flat and stratified, less often cylindrical or ciliated; more rarely all combined. Flat epithelium may be stratified alone, or exist in layers with a deep layer of pyriform or irregular cells, or with a rete Malpighii and papillæ below it, combined with sweat- and sebaceous glands and hair-follicles. Flat epithelium, with a rete Malpighii, sweat- and sebaceous glands, or hair-follicles, is characteristic of cysts having their origin in the sinus cervicalis. Cylindrical, ciliated epithelium, with a capsule of fibrous and adenoid tissue, is characteristic of origin from an internal cleft. Where both varieties exist together, the tumor comes from an abnormal rupture between the internal and the corresponding external cleft, with closure of the ends.

Diagnosis.—This is based on the congenital origin of the tumor; its location, its contents—cystic, unilocular, or multilocular—and the character of the cyst-wall.

Treatment.—Aspiration of contents and injection of tincture of iodine. Pure carbolic or other irritant is not to be recommended. If contents be aspirated, every antiseptic precaution should be used, though even at the best the benefit is only temporary.

Complete excision is the best treatment, though in this the greatest care should be exercised, as the cyst is usually closely connected with the larger vessels and other important structures. In excision none of the wall should be left, or, if impossible to thoroughly remove it from the adjoining important structures, the epithelial covering of the capsule should be carefully scraped away, using, of course, every antiseptic precaution; and the wound should be dressed and closed antiseptically, with or without drainage, according to the necessities of the case.

Injuries of the Neck.

Contusions.—These are of course subcutaneous wounds, and, though the gravity of the injury depends upon the particular parts which are damaged, contusions of the neck are apt to be followed by serious consequences. They are commonly the result of blows, hanging, garrotting, throttling, being run over, etc. Single or multiple lesions of almost every structure in the neck may thus be produced. Death may follow instantly, as in hanging, by "breaking the neck," which consists in the dislocation of the atlas from the axis, causing the odontoid process of the latter to sever or destroy the spinal cord at its exit from the skull. Life has been known to be suddenly terminated by a blow close to or upon the thyroid cartilage, and yet no lesion of the larynx or trachea has been found after death.

With every contusion there is always more or less hemorrhage from the rupture of larger or smaller blood-vessels, and the other lesions may be complicated with emphysema if communication is established with the respiratory tract, or with cellulitis if micro-organisms are introduced from within (through a wound of the œsophagus, pharynx, larynx, or trachea), or from without (through some interruption in the continuity of the skin), or if they are liberated from some pre-existing encapsulated focus.

The symptoms and treatment of a contusion of the neck depend upon the particular part or parts which have been injured, but inter-

ference with respiration, when present, will generally claim the first attention of the surgeon. The neck and chest should be bared, and, if the lumen of the larynx or trachea appears occluded, tracheotomy should be immediately performed below the point of injury. Artificial respiration may have to be at once instituted, and continued for a considerable length of time. But even after life has been restored death may eventually ensue, especially in cases which have suffered hanging, from œdema of the lungs coming on several days subsequently. Furthermore, when all danger is apparently passed there is a possibility that the patient may suddenly be killed by the detachment of a clot formed about a rupture in the intima of one of the great vessels of the neck. A better understanding of the dangers connected with a contusion of the neck can be had from a detailed description of the lesions which may thus be produced in the various important structures in this region. The respiratory organs, being those which commonly cause the most urgent symptoms, will be taken up first.

THE THYROID CARTILAGE. — Cases of fatal syncope have been recorded from a blow upon this cartilage, with no demonstrable lesion after death. In other instances laryngeal spasm may be produced, or an effusion of blood beneath the mucous membrane may take place, and when this occurrence has been noted the effusion has generally been found on one or other side above the true vocal cords. The symptoms of the latter condition are a greater or less amount of dyspnœa, hoarseness, cough, and dysphagia, and the recognition upon laryngoscopic examination of localized swelling in the above-mentioned situation. If respiration is markedly interfered with, tracheotomy should be performed at once; otherwise, cooling lotions applied to the outside of the neck would probably suffice, though the patient should be closely watched for some time to guard against any sudden attack of dyspnœa.

Fracture of the thyroid cartilage is a common and very dangerous complication of contusions of the neck. It may be accompanied at the same time by fracture of the cricoid cartilages or of the hyoid bone or by rupture of the trachea. The latter has in some instances been found completely severed from the larynx. The thyroid cartilages may be crushed from side to side or from before backward. It is rendered predisposed to fracture by ossification, and hence this accident is most common in old people. There will be extravasation of blood on the outer side of the cartilage, and on the inner beneath the mucous membrane, or, if the mucous membrane is ruptured, into the interior of the larynx. The vocal cords may be displaced, giving rise to fatal spasm of the glottis. The arytenoid cartilages may be dislocated, and the laryngeal muscles or the superior or inferior laryngeal nerves may be damaged at the same time. The œsophagus has been known to be opened coincidently, as well as the internal jugular vein, and, in fact, every structure in the neighborhood of a fractured larynx may show some lesion, though these lesions are of comparatively slight clinical interest, inasmuch as the force required to produce such extensive damage would probably cause death before the surgeon could interfere.

The **symptoms** are, as a rule, very pronounced and urgent. There is great dyspnœa, anxiety, and cyanosis, with a rapid and feeble pulse. The voice is altered in pitch and quality, or phonation may be impos-

sible. Pain and dysphagia are usually pronounced, and there will be more or less swelling and deformity. If the mucous membrane has been ruptured, emphysema may develop, extending downward into the mediastinum as well as over the neck, face, and arms, and blood will be coughed up or it may escape into the trachea in such quantities as to cause asphyxia. Palpation will generally reveal crepitation and abnormal mobility, though the swelling and emphysema may render this test impracticable. Fractures of the cricoid cartilages are very apt to be fatal, and the diagnosis will in most instances not be made till after death. In passing it should be remarked that rare instances of fracture of the thyroid cartilage have been noted which caused scarcely any subjective symptoms.

As regards the **course** and **prognosis**, death may immediately ensue from asphyxia, or may occur after the lapse of a few days from displacement of the fragments and spasm of the glottis, from infection and œdema, the entrance of blood into the air-passages, mediastinal emphysema, or from inhalation-pneumonia if the superior laryngeal nerves have been destroyed; from the effects of tracheotomy, etc. A stenosis of the larynx may subsequently develop if the parts unite in malposition or if there is any cicatricial contraction about the glottis, and may necessitate the wearing of a tracheal cannula permanently. It is also possible for necrosis to occur, and abscesses and fistulæ may form later.

In the **treatment** of fractures of the thyroid cartilage tracheotomy is almost always called for, and, even in the rare cases in which no dyspnœa exists, unless a medical attendant is constantly close at hand, tracheotomy would probably be indicated to guard against any sudden respiratory obstruction from œdema, displacement of the fragments, etc. It may be found possible to put the fragments in proper position by means of instruments introduced through the tracheotomy-wound. If this cannot be done, the thyroid cartilage may have to be split in the median line with every antiseptic precaution, any blood-clots or shreds of tissue removed, and the parts again brought into their normal relationship and retained there with catgut sutures, the laryngotomy-wound being then closed with catgut or silk.

Fracture or Rupture of the Trachea.—This is a much more uncommon accident than fracture of the hyoid bone or larynx, but is produced in the same general manner. The rent may be vertical, oblique, or transverse; it may involve a portion or the whole of the circumference of the tube, which may be completely torn from its connections with the larynx or divided in any part of its course, the segments being sometimes separated by as much as an inch or more. Rupture of the trachea at its point of bifurcation or of one of the bronchi is a rare accident, and necessarily fatal from the associated injuries and the great amount of violence necessary to produce it.

The **symptoms** are like those of fracture of the larynx or of very violent dyspnœa, with an excessive amount of emphysema, which generally causes pneumothorax.

The **diagnosis** may be difficult to make, but after excluding fracture of the thyroid cartilage the pain and tenderness, together with the other symptoms and the history, should make it reasonably certain. Patients

with this kind of injury usually die immediately or in the course of two or three days. The few instances of recovery which have been noted show that a hoarse cough is apt to persist, and more or less dyspnœa from cicatricial stenosis of the trachea.

The **treatment** of this form of injury would consist in tracheotomy, if possible below the point of injury; at any rate, the end of the tracheal cannula should extend beyond the obstruction. At the same time mucus and blood-clots should be cleaned or sucked out, and the rent in the trachea narrowed by sutures introduced through the loose connective tissue upon the outside of the trachea, and the head and neck immobilized in a flexed position.

FRACTURES OF THE HYOID BONE are discussed elsewhere. But it may be mentioned, in passing, that the symptoms are marked pain and difficulty in swallowing, especially of fluids, which are apt to cause paroxysms of coughing, perhaps from insufficiency of the epiglottis. If the fragments perforate the mucous membrane of the throat, there may be considerable hemorrhage, and the patient complains of a sensation like that produced by the lodgement of a fish-bone.

If abnormal mobility and crepitation can be detected, the **diagnosis** would be assured, but simultaneous fracture of the thyroid cartilage may cause confusion.

The **treatment** consists in rest and immobilization, as far as possible, with strips of adhesive plaster, and the administration of fluid nourishment by means of a stomach-tube if it cannot be taken otherwise. A prophylactic tracheotomy may be, and is usually, indicated to prevent death by œdema glottidis.

RUPTURE OF ONE OF THE LARGE VESSELS may be caused by a contusion of the neck, and death may be caused instantly by the entrance of particles of fat and their lodgement in the brain or lungs. The extravasation of blood, which may pulsate if from an artery, might give rise to urgent symptoms and call for tracheotomy or the exposure and ligation of both ends of the bleeding vessel. In hanging or garrotting the intima of the carotid or internal jugular is generally torn, and, should the sufferer from this form of violence recover, it is possible for death to be caused suddenly at a later period by the detachment of a clot. The same lesion may also give rise to a traumatic aneurysm.

INJURY OF THE SUPERIOR LARYNGEAL NERVE has been known to cause death instantly, or, if both are divided, the resultant anæsthesia of the larynx would terminate in an inhalation-pneumonia. If the *recurrent* nerve or nerves were divided, the main difficulty would be the loss of function. Almost any of the cervical nerves may be injured by a contusion of the neck, but as the symptoms which each causes will be taken up in discussing wounds of this region, the reader is referred to the description there given.

RUPTURE OF THE ŒSOPHAGUS, owing to its deep situation, is rarely met with in contusions, and, when it is, the associated injuries are apt to be so great as to render this occurrence a matter of merely post-mortem interest. Should the patient survive the immediate effects of the violence, there will be noted rapid swellings, hæmatemesis, and dysphagia, which is perhaps complicated by spasm or œdema of the larynx, necessitating an immediate tracheotomy. Subsequently infection and a cellu-

litis of the neck would in all probability develop and call for the treatment appropriate to this condition.

If the diagnosis of subcutaneous rupture of the cervical portion of the œsophagus could be made, the proper treatment would be to cut down upon the rent from the anterior border of the sterno-mastoid muscle, and, after thorough disinfection of the parts, to pack the wound and allow it to heal by granulation.

The *muscle* most commonly injured in a contusion of the neck is the sterno-mastoid; if it is ruptured, the symptoms are pain and more or less inability to turn the head toward the opposite side, localized tenderness, and possibly an appreciable gap somewhere in its course, with an extravasation of blood at this point.

Immobilization of the head and neck for a couple of weeks will probably be all the treatment required.

Any of the other muscles may be divided by contusing violence, but the symptoms and treatment are unimportant and would be merged in those of the concomitant lesions.

Wounds of the Neck.

It is important to note the nature of the instrument which has inflicted the injury, whether long or short, sharp or blunt, and whether it was clean or dirty; also, the circumstances which have attended the reception of the wound, such as the position of the head and neck and the direction in which the blow was struck or the knife passed, etc. If the wound is from a bullet, the distance at which it was fired has a bearing upon the case, inasmuch as nearly spent balls may take a less direct course than similar missiles coming from close at hand. When the head is thrown back, and the sterno-mastoid muscles consequently brought forward, the deep vessels and nerves will be more protected than under the reverse conditions, and hence a suicide may fail to wound the jugular or carotids, while the larynx or trachea are well exposed and probably opened. A wound may be inflicted from within, through the floor of the mouth, by falling upon a pipe, tin putty-blower, etc. held between the teeth, or through the œsophagus by the entrance of foreign bodies, as in sword-swallowing or the passage of bougies. The position, direction, and depth of any wound of the neck must be taken into account. By *superficial* is commonly understood one which does not penetrate deeper than the outer layer of fascia, and hence, of course, could be easily handled, though it is possible for even this kind of injury to prove very serious by entrance of air into a divided external jugular vein. A transverse wound would gape, while one having a vertical direction would have much less tendency to do so, and hence offer greater resistance to the escape of blood. On the other hand, a wound which follows the general direction of the muscular fibres is more apt than one which is transverse to be complicated by emphysema if the air-passages are opened. A self-inflicted wound is generally much lacerated and irregular, its margins being frequently hacked in different directions, and containing many parts which, though still remaining attached, will eventually slough. Foreign bodies, like bits of clothing, splinters of wood or iron, bullets, or any septic material, may be buried in its

depths. The various structures which may be severed, and consequently the prognosis and treatment, will depend upon the course which the wound takes, its extent, depth, etc., and, as the parts constituting the neck are very numerous and important, a better knowledge of this subject can be obtained by taking up each separately.

The hemorrhages, being generally the most prominent symptom encountered, we shall first discuss *wounds of vessels.* As stated before, the bleeding is more profuse from a transverse than a longitudinal wound, and any condition causing dyspnœa will increase that coming from divided veins, as evidenced during the performance of tracheotomy for respiratory obstruction. After inserting the cannula the hemorrhage, which till then may have been very profuse, will often be found to cease spontaneously.

A large vessel which has been opened in the course of a punctured or longitudinal wound of the overlying soft parts may permit a great amount of blood to escape between the layers of fascia, although little may appear externally. This may burrow downward a long distance, and cause symptoms due to pressure upon the different important organs in the neck or thorax, and at the same time prove an excellent soil for the development of micro-organisms. A traumatic aneurysm can be formed if the resistance of the cellular planes finally checks the outpour of blood and the latter remains in communication with the lumen of the artery. If the trachea or œsophagus is opened simultaneously with a vessel of any considerable size, blood will be poured into it in quantities depending upon the size of the vessel and the wound. Should the latter be large and gaping, the blood might find a more ready escape externally; but if it is a mere puncture, the overlying parts, by sliding upon each other, might obliterate the track of the instrument inflicting the injury, and under these circumstances hæmoptysis or hæmatemesis might be noticed.

Wounds of veins in the neck, especially of the internal and external jugular, the subclavian, and the innominate, are the ones in which the dangers caused by the entrance of air have been most frequently observed. These vessels, being in close proximity to the heart, have scarcely ever a positive pressure within them, and with every inspiration it becomes decidedly negative. Added to this, their fascial connections prevent them from collapsing perfectly after they are wounded. They thus gape open, and unless they happen to lie in a cavity in which the blood escaping from the distal end covers the divided proximal portion, air is very apt to be sucked in. If a considerable amount enters the circulation, death is of course very speedily brought about by embolism of the small pulmonary or cerebral vessels. Such an accident is of very rare occurrence, but it is worth noting that it has been known to occur through the infliction of a very small wound, one fatal case being recorded in which it took place during the passage of a seton into the fore part of the neck.

A wound of the *innominate* artery is necessarily fatal, especially as assistance may not be obtainable on the spot. Either this vessel or its accompanying vein may be wounded in the performance of a low tracheotomy, as may the *thyroidea ima* artery, a branch passing from it to the thyroid gland and lying low down, nearly in the median line. The *sub-*

clavian artery or vein is sometimes cut in a stab- or gunshot-wound, and at the same time one or more of the branches of the brachial plexus may be injured. If the patient does not immediately die from hemorrhage or the entrance of air into the vein, a hæmothorax is very apt to follow. A wound of the *carotid* arteries or *internal jugular* vein will speedily cause death from loss of blood or the entrance of air into the vein. But it is said to require four minutes to terminate life by division of the internal or external carotid, while two minutes is all the time which is required for ligating either. The *thyroid*, *lingual*, *vertebral*, and *ascending pharyngeal* arteries are generally injured only by punctured or gunshot wounds, though the last-named vessels are thought to have been the cause of the hemorrhage which has sometimes resulted from tonsillotomy. Should the patient escape from the immediate effects of a wound of one of the great vessels of the neck by the formation of a thrombus, there will be the same subsequent danger of its detachment as in contusions, and, in addition, the greater one of pyæmia if septic matter has been introduced with the instrument inflicting the damage, or if it gain entrance to the tissues through a simultaneous wound of the pharynx or œsophagus.

The **diagnosis** of a wound of a vessel is extremely simple, but the particular vessel which is affected cannot always be readily made out. The character and manner of the production of the injury, the instrument, and the direction of its course must be taken into consideration. If the wound is wide and gaping, the bleeding may be so profuse as to terminate life in a very short time. If a deep puncture, the rapidly-enlarging hæmatoma and the accompanying pressure-symptoms may call for equally prompt relief. The color of the blood will not present much of a guide as to whether the hemorrhage is arterial or venous, inasmuch as both classes of vessels are almost certain to be divided simultaneously in a wound of any extent. But "spurting" is of course a conclusive proof that an artery has been divided. Should the air-passages have been opened, there may at the same time be symptoms of asphyxia from blood gaining access to the respiratory tract. The entrance of air into a vein is accompanied by a more or less wind-sucking or gurgling sound, and immediately the face of the patient will become blanched, the pupils widely dilated, the heart irregular and tumultuous, the breathing embarrassed, and death may speedily supervene.

The **treatment** of wounds of vessels in this region does not differ materially from that of those met with elsewhere. Pressure by the finger applied directly upon the bleeding point is of course the first resource. In addition, the main trunk of the vessel may be compressed on the proximal side of the wound, but the anastomosis is so free in the neck that this manœuvre to be at all effective will generally have to be supplemented by pressure on the distal side. The subclavian can sometimes be compressed against the first rib by pushing firmly downward with the finger close above and behind the middle of the clavicle—the carotid by pressure against the carotid tubercle or transverse process of the sixth cervical vertebra. Packing the wound firmly with anything at hand may answer temporarily for all but the largest vessels. But in the end individual ligation of each bleeding point must be undertaken, and to do this the wound may have to be enlarged in any required direction. It

will rarely be found necessary to tie the common or external carotid to check hemorrhage from the branches of the latter; these may be the internal maxillary, the deep temporals, or the ascending pharyngeal.

The **treatment** of bleeding from any of the great veins does not differ materially from that of the arteries. It is more easily controlled by digital pressure or by packing, but at the same time the danger of aspiration of air must not be overlooked. This accident is facilitated by the absence of blood in the wound, and consequently the instant such an occurrence is noted the open mouth of the vessel should be immediately buried in water, as may be done, for instance, by squeezing the contents of a wet sponge into the gap in the tissues or by pressure with the finger on the proximal portion of the vein while the distal is allowed to bleed. Forcible compression of the chest may drive the air out again, while at the same time the patient's head should be lowered, both ends of the vessel quickly ligated (pressure on the proximal side being maintained meanwhile), and artificial respiration instituted if necessary. Fortunately, small amounts of air thus taken into the blood are not always fatal.

After arresting the hemorrhage and attending to respiration the wound should be thoroughly searched for foreign bodies, carefully disinfected, and drained. The danger of secondary hemorrhage in the course of the days immediately succeeding the reception of the injury is a real one, especially in attempts at suicide, where the instrument employed is apt to have been dirty and the parts much lacerated. Consequently the patient should not be left long unguarded at first.

WOUNDS OF NERVES.—Almost any one or more of the nerves in the neck may be injured by a wound in this region.

The **diagnosis** is based upon the nature and location of the external lesions, the instrument (knife, bullet, club, rope, etc.), and the direction and distance it has passed through the tissues or the situation of the contused spot if there has been no superficial wound. The brachial plexus may be damaged by a fractured clavicle or a stab, and according to whether its trunk or trunks are partially or completely divided there will follow a greater or less amount of motor and sensory paralysis in the corresponding arm. If the loss of function is not total and soon begins to improve, there will only have been a contusion of the nerves, although it is possible for an extensive anæsthesia to greatly decrease in course of time, on account of the place of the injured sensory nerves being taken by collateral branches. But a paralysis from a simple contusion may persist, as when the plexus becomes involved in the callus after fracture of the clavicle. Degenerative processes may also be caused by the pressure dependent upon the contraction of a cicatrix or the healing up in the wound of a foreign body like a bullet. If, however, sudden paralysis of greater or less extent follow immediately the reception of any wound, generally a puncture, the latter should be enlarged sufficiently to expose the divided nerve-trunks, which should then be brought together by sutures, as described in the article on Surgery of Nerves.

Should it be necessary to expose the *brachial* plexus to relieve a pressure-paralysis or for exploration, it can be reached by a longitudinal incision extending upward from the clavicle some three inches along anterior border of the trapezius muscle. After drawing downward the

omo-hyoid, the plexus will be found lying on the scalenus medius in the space between the scalenus anticus and sterno-mastoid on the inner side and the trapezius on the outer.

The *cervical* plexus can be exposed by an incision of similar size starting about three fingers' breadth below the mastoid process and running along the posterior border of the sterno-mastoid.

The *pneumogastric* nerve may be divided by an accidental wound of the neck or in the course of the extirpation of tumors, or it may be included in the ligature when for any reason the common or internal carotid artery or the jugular vein is tied. Its recurrent laryngeal branch may be similarly injured during the removal of a diseased thyroid gland or ligation of the inferior thyroid artery. Division of the vagus upon one side ordinarily produces no noticeable effect upon the pulse and respiration. If the lesion lies above the point at which the recurrent branch is given off or if it involves the latter, there will of course be a paralysis of the corresponding side of the larynx. But when the pneumogastric and recurrent nerves on both sides are severed, there will be a paralysis of the muscles which open the vocal cords, and death will follow from tachycardia, pneumonia, or œdema of the lungs.

Division of the *superior laryngeal* nerve may be brought about in the same way, and causes a partial or complete anæsthesia of the larynx according as one or both nerves are involved, and this permits foreign bodies to enter and set up an inhalation-pneumonia.

The *hypoglossal* nerve may be wounded in attempts at suicide, and this gives rise to motor paralysis of the corresponding half of the tongue. Its superficial position along the upper border of the hyoid bone on the outer side of the hyoglossus muscle might offer hopes of successfully suturing it.

The *phrenic* nerve may be cut in a stab-wound of the neck low down, and then would occasion embarrassment of respiration from paralysis of the corresponding half of the diaphragm.

Instances of division of the *sympathetic* nerve in stab- or bayonet-wounds of the neck or from extirpation of tumors in this region are on record. The most constant symptoms are a contraction of the pupil and vasomotor disturbances, such as flushing of the face and conjunctiva, and an increase of the lachrymal and sweat secretion, and in old cases a retraction of the bulb of the eye on the corresponding side.

Division of the *spinal accessory* nerve causes paralysis of the muscles which it supplies—namely, the sterno-mastoid and trapezius—and eventually the deformity known as paralytic wry neck. This nerve can be exposed by a three-inch incision extending downward from the mastoid process along the anterior border of the sterno-mastoid. The nerve lies beneath the posterior belly of the digastric about two inches below the apex of the mastoid process, and can be identified by the symptoms of irritation produced in the sterno-mastoid muscle by pinching up or drawing the finger-nail or other blunt instrument across the structure believed to be the nerve in the bottom of the wound thus made. It is also possible to expose the spinal accessory by a three-inch incision parallel to, and having its centre opposite the middle of, the posterior border of the sterno-mastoid. At this point it emerges from behind the muscle to

cross the occipital triangle, and after being found can be traced backward toward its origin.

In all cases where the diagnosis of division of a nerve can be made, the latter should be sought for with the strictest antiseptic precautions, enlarging the wound if necessary, or even making a fresh one in a more convenient location, and the severed extremities united by sutures.

WOUNDS OF THE ŒSOPHAGUS are discussed elsewhere, but, as this organ is sometimes injured in conjunction with other structures in this region, a brief discussion of the subject should be given. It may be pierced from within by the swallowing of a pointed foreign body or by the passage of a bougie, or from without by a knife, bullet, bayonet, etc. Wounds made from without are of course liable to cause injury to so many other adjoining important structures that death speedily results. If completely divided in a more or less transverse direction, there will follow a considerable separation by retraction of the segments. A wound involving the entire thickness of the wall of the œsophagus is always liable to be complicated by deep cellulitis of the neck, with the dangers attendant upon this condition (burrowing of pus into the mediastinum, pleurisy, pneumonia, septicæmia, pyæmia, etc.), and subsequently, if the patient recover, there is a possibility of the development of cicatricial stenosis or of an œsophageal fistula.

The diagnosis in the case of a wound made from without may be simple if the parts have been laid wide open, or difficult or impossible if there has merely been a puncture. Should food, drink, saliva, or vomitus appear externally through an aperture in the neck, there could be no doubt about the character of the injury. The other symptoms would be mainly pain on swallowing and the vomiting of blood. The diagnosis of a punctured wound made from within would have to rest upon the severe pain and possibly collapse-like symptoms manifested upon the reception of the injury, and later by the development of more or less cellulitis and fever.

The prognosis of punctured wounds of this organ is not as bad as might be supposed. If the hole is small and made by an aseptic instrument, and the patient does not force infectious matter into it by vomiting (the dysphagia would probably prevent the swallowing of quantities of matter sufficient to distend the wounded wall of the œsophagus), such an injury may get well without causing any serious symptoms.

The treatment in the case of a small puncture is mainly expectant, but at the first symptom of cellulitis, as always in large wounds, the affected part should be freely exposed by an incision along the anterior border of the sterno-mastoid muscle, and after closing the opening in the œsophagus by sutures introduced through the soft connective tissue upon the outside of the canal, the outer wound should be well drained and packed with iodoform gauze, and left to heal by granulation. It may be necessary to nourish the patient during repair of the wound by a tube introduced into the stomach.

WOUNDS OF THE AIR-PASSAGES are described in another section, but, as the condition in which they are most frequently encountered—namely, "*cut-throat*"—is common, and may present features which must be instantly met, the surgeon should be given some hints upon which to act in such an emergency. The wound may be inflicted with almost any

kind of instrument, and hence is very apt to become infected. Furthermore, it is commonly much lacerated and very irregular, and if low down the depth will be influenced, somewhat as stated before, by the tension or relaxation at the time of the sterno-mastoid muscles. Its location, though this may vary from the irregular character of the incisions, may be above the hyoid bone, through the thyro-hyoid membrane, the thyroid cartilage, or the trachea. It will rarely involve the œsophagus. Except in the most superficial and unusual form of this kind of wound the air-passages will generally be opened at one or more points. At the same time the root of the tongue or the base of the epiglottis, or some structure at the entrance of the larynx, may be divided, and, falling back, occlude the aperture of the glottis or set up a fatal spasm of the latter. Liquid or coagulated blood may similarly block the respiratory tracts and speedily cause suffocation. Emphysema is sometimes encountered, especially when the external cutaneous wound is small. Rarely, death may be caused by the entrance of air into an opened vein. The dangers which follow the immediate ones of hemorrhage and asphyxia from mechanical occlusion of the larynx or trachea are an acute inflammatory œdema of the glottis when its interior is wounded or freely exposed to the effects of traumatism from without; œdema-pneumonia or gangrene of the lungs from the entrance of foreign or septic matters; cellulitis, and later cicatricial stenosis of the air-passages or œsophagus. Tracheal or œsophageal fistulæ are a remote possibility.

That the respiratory tract has been opened can be recognized by the cough and bloody expectoration, and by the hissing or bubbling sound which is heard as the air mixed with blood enters or leaves the external wound.

The first **treatment** must be directed toward the arrest of hemorrhage by pressure or by clamping the larger vessels, but during this the respiration must not be overlooked. If there are evidences of dyspnœa, the entrance to the larynx is to be quickly examined, and any clots or foreign bodies which may be found in it removed; the tongue or epiglottis should be drawn forward by a clamp or by a suture passed through it, and, if breathing has ceased, artificial respiration must be instituted, while at the same time any blood which may have got into the trachea is sucked out by a rubber tube or catheter. When air has been heard to enter a vein, the thorax should be forcibly compressed in hopes of expelling it, while the cavity of the wound is filled with water. For the collapse attending upon this accident or the hemorrhage the patient is to be placed in an inverted position, head down, and stimulants like ether, whiskey, carbonate of ammonium, etc. freely administered. After the immediate dangers have passed the wound can be thoroughly cleaned and disinfected and explored. An opening into the pharynx or œsophagus is to be closed by a row of catgut sutures through the mucous membrane, and another through the outer wall, over which it is best to place at least a strand or two of iodoform gauze. The trachea or larynx if cut is to be treated in the same way, though it may seem better to leave the wound partly open when below the thyroid cartilage, as a resource in case of œdema of the glottis. The patient must be carefully watched for this occurrence during the days immediately following the accident, and at the first symptoms of such obstruction intubation or

tracheotomy performed. Carefully continuing the exploration, the epiglottis, the thyro-hyoid membrane, the muscles attached to the tongue above, and the hyoid bone or thyroid cartilage below, are sutured, layer by layer, in their proper anatomical position, together with any nerves which can be found. Here and there intervals should be left to permit drainage by strands of catgut or iodoform gauze. If everything goes well, these can be removed in twenty-four to forty-eight hours. The external wound is then partially closed and packed, with the head immobilized in a flexed position. Feeding may have to be carried out *per rectum* for the first week or by a stomach-tube, possibly passed through the nose. It is considered best by some surgeons to introduce a tracheotomy-tube below the wounded trachea as a prophylactic measure to prevent an œdema glottidis.

Burns of the Neck.

Burns in this locality are chiefly of interest from the deformity which they may give rise to in healing. The lips, mouth, chin, or the entire head may thus be drawn into distorted and unsightly positions. In the early stages, when granulations have formed, Thiersch skin-grafts may prove serviceable in lessening or preventing the subsequent contractions. Later, after cicatrization has become completed, massage or electricity offers a little hope of improvement, but in bad cases the best results will be obtained from some form of plastic surgical operation.

Burns of the *pharynx*, *œsophagus*, and *respiratory tracts* are discussed elsewhere.

Diseases of the Neck.

Skin.—This is subject to all the common surgical diseases, and needs no extended mention. Erysipelas is a frequent affection, owing to the exposed position of the part. Most of the congenital, parasitic, and inflammatory diseases peculiar to the skin might be enumerated, the most frequent being eczema. Carbuncle is very often encountered, and is very generally located on the posterior aspect of the neck. The syphilodermata are described in another place. Tuberculosis—notably lupus—is principally worthy of remark on account of the deformity it occasions. All ulcerative affections of the integument in this locality should be treated with especial care, owing to the possibility of infection and the dangerous forms of cellulitis which may thus be set up.

Cellular Tissue.—A knowledge of the arrangement of the fascia is exceedingly important for a proper understanding of the particularly dangerous cellulitis which often occurs in the neck.

The different layers form spaces which communicate with each other and the mediastinum, and contain muscles, vessels, nerves, glands, and cellular tissue. One space, called the jugular, lies on each side of the neck and encloses the carotid artery, internal jugular vein, and pneumogastric nerve; one encloses the sterno-mastoid muscle; and another, subdivided into two, ensheaths in front the larynx and trachea behind the œsophagus, the latter being called the retrovisceral and the former the

previsceral space. The fascial cleft, where the submaxillary gland lies, communicates with the jugular, and through it with the axillary space, and also with the mediastinum, the anterior portion of which is continuous with the previsceral and the posterior with the retrovisceral space. At the root of the neck, just above the arch of the aorta, all these spaces communicate more or less freely, and as pus can traverse the loose cellular or muscular tissue they contain much more easily than the denser fibrous boundaries, the dangers may be readily understood. On the surface the platysma is closely attached to the skin, and has beneath it the fascia which is attached to the jaw and zygoma above and the clavicle below, and hence a superficial inflammation may extend from the neck over the chest.

The most important lymph-glands are the submaxillary group, below the angle of the jaw, which communicate with the lips and gums, the superior superficial and deep glands, and lower down the inferior superficial and deep glands, communicating with the nose and pharynx above and the mediastinal glands below. There are other glands, situated in the occipital region, receiving the lymphatics from the scalp behind and from the mastoid region; also some over the clavicle behind the sterno-mastoid muscle. Others which are frequently found enlarged or suppurating are located behind the auricle, in front of the tragus of the ear and just above the episternal notch.

Cellulitis of the neck may be acute or chronic, circumscribed or diffuse, superficial or deep, but is always due to the introduction of micro-organisms. When superficial the source of the *acute* form is to be sought for in some abrasion-wound or pre-existing disease of the scalp, face, ear, or mastoid region. From this the inflammation may extend directly to the region beneath the skin and platysma, or it may first involve the lymphatic glands. When the latter structures appear to be the primary focus of infection, the inflammation is apt to be more chronic, and is generally due to syphilis or tuberculosis. The deep acute form of cellulitis starts from the entrance of micro-organisms, usually through the nasal, oral, or pharyngeal cavities; from an ulcerative inflammation in the nose; from a carious tooth, giving rise to a periostitis or osteomyelitis of the inferior maxilla; from suppuration of the salivary glands; from caries or necrosis of the cervical vertebræ; or it may occur in the course of such infectious diseases as scarlet fever, small-pox, diphtheria, typhoid, pyæmia, etc. The deep like the superficial cellulitis may arise by direct extension of an inflammatory process in the neighborhood through the cellular tissue, or the infection may travel in the lymphatics, causing first an adenitis and localized process, and later, after the gland breaks down, a diffuse phlegmon. The affection is generally located in the antero-lateral region of the neck, and is more often deep than superficial. It may travel downward into the mediastinum through the jugular space, or into the axilla, or come to the surface anywhere above the clavicle. Should the inflammation be external to the outer layer of fascia and remain so, it may work its way downward on to the thorax.

"Ludwig's angina" is a somewhat vague term used to designate a deep cellulitis taking its origin in the neighborhood of the submaxillary gland, and, if allowed to continue, burrowing downward, usually into the

jugular space. Inflammation in the previsceral or retrovisceral space is much rarer, and is generally the result of injuries (wounds) or disease of the respiratory or alimentary tract, although there is an acute form of retropharyngeal abscess which is caused by infection from the naso-pharyngeal mucous membrane. As examples of disease occasioning acute cellulitis in this locality mention might be made of carcinoma of the œsophagus with perforation of the latter, or septic inflammation of the thyroid gland.

Chronic cellulitis of the neck generally begins in the lymph-nodes as a result of tuberculosis, syphilis, glanders, actinomycosis, etc.; less often it originates from disease of the laryngeal cartilages, the inferior maxilla, cervical, vertebral, or mastoid cells, or from the breaking down of a cancerous process in some portion of this region. There may be a more or less circumscribed collection of pus, as in the case of retropharyngeal abscesses, or the parts may be matted together in an indistinguishable œdematous mass and riddled with fistulæ leading very probably to broken-down or calcareous lymph-glands. The latter, by the way, usually before actual suppuration has occurred, are sometimes so large as to cause symptoms from pressure upon important structures like the recurrent laryngeal nerve, the larynx, trachea, or œsophagus. At any time a chronic cellulitis which has been more or less circumscribed may take on an acute character from the entrance of pyogenic organisms, usually through a fistulous tract, and, spreading beyond the original layers of fascia which enclosed it, change from a comparatively mild or superficial affair to a deep form of the acute disease with all its dangers. These are œdema of the glottis, mediastinitis, purulent pericarditis or pleuritis, abscess of the lung, septicæmia, etc. Rarely the pus may rupture into the œsophagus or into the trachea; in the latter case it would generally cause death by asphyxia. The most favorable termination is a spontaneous evacuation of the pus through an opening on the surface of the neck. In all cases of cellulitis in the neighborhood of the great vessels there is a possibility of the walls of the latter becoming involved, giving rise to a septic thrombus which may be carried into the circulation and cause metastatic deposits of infectious matter, a pyæmia, or general miliary tuberculosis. It must always be borne in mind that a superficial localized inflammation may pierce one or more layers of the fascia ordinarily limiting its progress, and change into a deep-spreading phlegmon.

The **symptoms** hardly vary enough from those of cellulitis elsewhere to require a separate description. They are the constitutional ones of suppuration, with, locally, pain, redness, heat, swelling, and œdema, and in addition the special ones caused by the interference with or loss of function of the particular parts which are affected. Such are immobility of the head, which may be turned or bent toward the side of the disease, dysphagia when the pharynx or œsophagus is involved, or dyspnœa when the inflammation is in the neighborhood of the larynx.

The **diagnosis** of a cellulitis located near the surface is not hard to make: the discoloration, tenderness, œdematous swelling, and fluctuation when obtainable cannot well be mistaken. A deeply-located process may, however, present some difficulties, but the constitutional symptoms of suppuration, aided possibly by an exploratory puncture with a

hypodermic needle, would probably indicate the true nature of the affection.

The **treatment**, like that of any other cellulitis, should be first directed toward the local inflammatory process and toward removing the original cause of the infection if it can be found. Free incisions should be made over the most prominent part of the swelling, in general following the longitudinal arrangement of the muscular fibres and the planes of fibrous tissue. This must not be delayed till there is a certainty of the presence of pus, especially when the œdema and induration indicate a diffuse process. After passing through the superficial fascia the opening can be deepened by a blunt instrument, thus avoiding injury to large vessels and nerves, which may be difficult to recognize in the swollen condition of the parts. Broken-down or cheesy glands should be extirpated or thoroughly scraped out, and all necrotic tissue removed as far as possible. If the inflammation has existed a long time, there may be sinuses running in all directions and diffuse matting together of everything. Under these conditions the best that can be done will often consist in enlarging the fistulous openings, scraping away all diseased tissue, and disinfecting the parts with a 1 : 1000 solution of bichloride of mercury as thoroughly as possible. The wound is then drained at its most dependent portions and packed with iodoform gauze. Complications, such as the burrowing of pus or metastasis, are to be met as they arise by free incision and disinfection. But the possibility of œdema of the glottis must never be lost sight of in any cellulitis of the neck. It is, of course, more apt to occur with a deep than a superficial process, but as the latter may easily change into the former or the chronic affection suddenly take on an acute character, the surgeon should always be on his guard against this very dangerous complication. Tracheotomy may be urgently needed to save life.

The treatment of retropharyngeal abscess is discussed elsewhere; that of cellulitis arising from wounds or perforations of the œsophagus, or which may start around a carcinoma from ulceration of the latter, does not differ from that of any deep suppurative inflammation in this region; it is simply free incision along the anterior or posterior border of the sterno-mastoid and drainage, coupled with an attempt to do away with the source of the infection. If disease of bone or cartilage in the neck is the root of the trouble, the appropriate antisyphilitic or antitubercular treatment should be instituted, necrotic portions removed, and the sinuses scraped and disinfected.

At the risk of repetition we call attention to the necessity of searching for the source of infection in every case. The scalp should be inspected for wounds, or lice which occasion scratching and abrasions, or eczema from which septic matter passes to the nearest lymph-glands, setting up in them inflammation of greater or less acuteness. For similar reasons the mastoid process and ear must be examined. An ulcerative process of the nasopharynx, of the mucous membrane, with enlargement and suppuration of the glands below the angle of the jaw, is often caused by a neglected catarrh of the nose, especially in poorly-cared-for children. The most common source of a cellulitis of the neck is a carious tooth or some root perhaps buried out of sight in the lower jaw, but still allowing the entrance of micro-organisms. The tooth

must always be drawn and the resulting cavity thoroughly disinfected. In severe constitutional diseases the mouth should receive constant attention to prevent its becoming foul, thereby permitting disease of the mucous membrane, which may give rise to suppuration of the salivary and lymphatic glands and the cellular tissue around them.

The general treatment comprises nursing, feeding, and stimulation, together with the treatment of individual symptoms as they occur.

MUSCLES.—The diseases peculiar to these structures in the neck are mentioned in other chapters. Suffice it to say that the most common are the various forms of torticollis which are due to affections of the sterno-mastoid. The latter muscle is sometimes the seat of a gumma tumor, the diagnosis of which can be most easily made by a short and vigorous course of antisyphilitic treatment. The various forms of myalgia, myositis, etc. do not differ materially from those in other regions.

DISEASES OF BLOOD-VESSELS.

These also are described elsewhere, including special aneurysms, but it might be well to briefly mention phlebitis of the internal jugular vein. This is almost always secondary to disease of the middle ear with septic thrombosis of the lateral sinus. The clot extends downward into the jugular, and generally, unless very energetically treated, gives rise to pyæmia and death. The affection can be recognized by the tense, tender cord deeply placed, and felt just in front of the anterior border of the sterno-mastoid muscle. There will of course be the other symptoms of the dangerous intracranial trouble of which it is a complication. After freely opening and disinfecting the mastoid cells and lateral sinus, the diseased jugular should be exposed and ligated below the thrombus, after which the affected portion is carefully excised and the resulting wound disinfected and drained.

DISEASES OF THE GLANDS.

The salivary, thyroid, and lymph-glands are fully discussed in other sections. But the cervical lymph-glands form the great majority of the tumors of the neck, becoming enlarged from inflammatory and neoplastic affections, and therefore it will be wise to briefly review the diseases with which they are commonly attacked. The boundary-line between inflammation and new growth of these structures is so vague clinically, both forms of change presenting tumefaction, that for purposes of description they can be grouped under "Tumors of the Neck." These are best divisible into tumors of the lymph-glands and tumors of the other parts. As regards the lymph-glands, it may be stated that the distinction between inflammation and new growth is by no means well marked, but it will serve for purposes of description.

TUMORS OF THE NECK.

LYMPH-GLANDS.

I. TUBERCULAR LYMPHADENITIS.—This affects the lymph-nodes of the neck (as well as those in any other part of the body) in two different

ways. One is commonly described as *simple* or *strumous lymphadenitis*, which occurs in so-called scrofulous or strumous individuals, who are generally children or people under twenty years of age. The glands show only a hyperplasia of their substance, without any tubercle-tissue and without any tubercle bacilli present in their substance. They, however, have a tendency to undergo cheesy degeneration in their interior. The cheesy material may break down from one cause or another, and purulent and necrotic inflammation may occur, with the formation of abscesses. Later, with the establishment of fistulæ, the inflammation may assume a tubercular character.

True *tubercular lymphadenitis* is very common in the neck. It may occur as a purely local affection, being confined to the lymph-nodes, or in conjunction with a general miliary tuberculosis, or with tubercular inflammation of some other part in the neighborhood. Simple inflammatory changes regularly take place around the periphery of the tubercular process. The tubercles in the glands may undergo cheesy degeneration, or become fibrous, or change into hyaline material, or rarely, if the process is very chronic, they may become calcified. Sometimes the cheesy material softens, and makes a cavity in the interior of a gland which is filled with grumous material. If pyogenic organisms gain access to the diseased focus through some interruption in the continuity of the surface drained by its lymphatics, acute inflammatory processes may occur in and around a gland containing this grumous material, and cause a general matting together of a whole string of lymph-nodes and the parts immediately surrounding them.

In the early stages of either a simple or tubercular lymphadenitis the glands will be found separate from one another, and each contained in a distinct capsule, from which they can be easily enucleated.

Symptoms.—There is a slowly but constantly growing mass or tumor in the region ordinarily occupied by the lymph-glands. It may be sharply defined and lobulated or not, according as one or more nodes are involved alone or with the surrounding tissues. There may be periods of quiescence when no change is observed, and rarely this quiescence may change into an atrophy and disappearance of the trouble spontaneously or with appropriate constitutional treatment for tuberculosis.

Tubercular glands may even occur in old age, but they are usually observed in children or young adults with the tubercular or "scrofulous" diathesis or with a tubercular family history. There is little or no pain accompanying the enlargement, except as acute inflammatory symptoms make their appearance. The formation of pus causes the manifestations of a suppurative inflammation, with matting together of the surrounding parts. This acute process may give rise to all the complications and dangers mentioned in Cellulitis of the Neck.

Rarely a tubercular lymphadenitis may prove to be the starting-point of a general miliary tuberculosis.

Treatment.—The best is thorough removal, though it may be preceded and should be followed by the constitutional treatment for tuberculosis. When the glands can be felt as distinct nodules, without much thickening of the surrounding parts, the operation may be comparatively easy, as the glands will be found capable of being shelled out of a capsule (after it is once opened), and, though the operation may have to be

much more extensive than first appeared necessary, the wound, if no pus is found, can be made to heal primarily. But it will often be impossible to foretell the presence of suppuration in the interior of the nodes.

In other cases, especially if suppuration and the formation of sinuses have taken place, extirpation may be very difficult or impossible, on account of the intimate connection of the mass with the important structures of the neck, and the surgeon will have to be content with opening and cleaning out all abscesses, slitting up and scraping sinuses, and concluding with thorough drainage and packing with iodoform gauze.

Both the patient and the surgeon should always be prepared for an extensive operation, which may have to be repeated one or more times, as there is considerable possibility of recurrence of the trouble.

Good results are sometimes obtained in this region, as elsewhere, by draining off the pus from a tubercular abscess with an aspirator, and then filling the resulting cavity with a 10 per cent. mixture of iodoform and melted vaseline. When removal of a diffuse, ill-defined mass is impossible, and there is no actual formation of pus, parenchymatous injections into the substance of the tumefaction of a few minims of a sterilized 10 per cent. emulsion of iodoform in olive oil have yielded good results, at least in arresting the progress of the disease. Excellent results have been obtained by painting over the swollen glands a solution of iodoform in styptic collodion, and alternating this with the ointment of the iodide of potash and mercurial inunction. Whatever method of treatment is adopted, the constitutional treatment for tuberculosis is essential.

II. Syphilitic Lymphadenoma.—During the *primary* stage, when the chancre is somewhere on the head (lips or mouth usually), the adjoining cervical glands show a simple acute inflammatory enlargement which has some tendency to suppuration. In the *secondary* stage the cervical, in common with all the other, glands are swollen and hard. In the *tertiary* stage gummata may form in them which may break down and form abscesses, sinuses, or ulcers, with more or less inflammation and matting together of the surrounding soft parts.

The **diagnosis** from tubercular disease is sometimes difficult to make. The history should be carefully inquired into, and symptoms of syphilis elsewhere sought for. In doubtful cases a decision may be reached by appropriate constitutional and local antisyphilitic treatment, aided possibly by microscopical examination of a portion of the tumor.

The **treatment**, in addition to that for the disease of which it is a part, conforms to the general surgical management of abscess or ulceration.

III. Secondary Lymphadenitis.—While not a strictly accurate term, this serves as a convenient heading for a large and common group of inflammatory tumors of lymph-glands. In this class would be included the lymphadenomata found accompanying *glanders*, *actinomycosis*, and *leprosy*.

The **diagnosis** would be based upon the original or accompanying lesions, and, in the case of the first two at any rate, upon the demonstration of the specific micro-organisms.

In any disease in which there is inflammation or ulceration of the nasal, oral, or pharyngeal cavities the cervical lymph-glands may become inflamed from the entrance into them of septic matter. Such diseases are measles, scarlet fever, diphtheria, typhoid and typhus fevers, pyæmia, or any severe constitutional affection in which the mouth becomes foul. Infected wounds about the head or neck, like those elsewhere, will always lead to inflammation, and often suppuration, of the nearest glands. Under this latter class come the troubles mentioned in the description of cellulitis of the neck following abscess of the jaw from a carious tooth.

The **treatment** is that of bubo—namely, thorough disinfection of the source of the trouble, accompanied, before suppuration of the glands has occurred, by counter-irritation over the tumor or the application of antiseptic cataplasms, such as a 50 per cent. ichthyol ointment or compresses wet in 1 : 60 carbolic solution, etc. Where pus has formed, incision and drainage must of course be practised. It may be advisable to dissect out the glands, as is often done in inguinal adenitis.

The neoplastic affections of the lymph-glands are comparatively few and may be grouped as follows :

I. Leukæmic Lymphoma or Lymphadenoma.—The cervical lymph-glands, as well as those of the abdomen, axilla, and groin, may become the seat of a slow or rapid, painless, circumscribed enlargement as part of the general disease known as leukæmia. The changes in the glands consist in a simple hyperplasia of their substance.

The **diagnosis** is made by the increase in the size of the nodes found in other parts of the body, the hypertrophy of the spleen, and abnormally great quantity of white blood-cells. The lymph-glands may be hard or soft, and then often simulate fluctuation.

II. Malignant Lymphoma (Pseudo-leukæmia or Hodgkin's disease).—The lymph-glands are enlarged in exactly the same way as in leukæmia, but the disease differs in that there is no increase in the number of white blood-cells ; also the lymphatic structures other than the nodes are not so prominently involved.

The **treatment** in both affections is mainly medical, as the tumors recur after removal. Hence operation would only be justifiable for the relief of urgent symptoms of pressure, such as dyspnœa or dysphagia. Internally, arsenic may be given, starting with five drops of Fowler's solution and gradually increasing the dose till symptoms of poisoning appear. Iron, iodide of potassium, or phosphorus may be combined with the arsenic. Billroth recommends the daily injection of two minims of Fowler's solution directly into the substance of the tumor. This is gradually increased to six minims.

III. Lympho-sarcoma.—This is mainly of the round- and spindle-celled variety, and clinically differs from the two preceding forms of enlargement in occurring primarily in a single gland. The tumor is most commonly met with along the course of the great vessels, and has a tendency to grow very rapidly, spreading beyond the capsule of the gland and involving all the surrounding structures. Ulceration takes place early, and, on account of the close connections with the vessels, metastases speedily appear.

The **symptoms** are those of a more or less rapidly-growing sarcoma,

generally with a smoothly-rounded outline at first, though this soon disappears. It usually appears in young persons, and if seen early enough the location in a lymph-node may be of assistance in making the diagnosis.

The treatment consists in as thorough and prompt removal as possible.

IV. SECONDARY OR METASTATIC LYMPHOMA.—Sarcoma may also affect a lymph-node secondarily from disease somewhere in the neighborhood. Carcinoma of lymph-glands is encountered only as the result of metastasis, inasmuch as the nodes contain no epithelial elements from which such a tumor could be formed. In every case of enlarged glands occurring after middle life a search should be made for a malignant growth if one is not perfectly apparent, and this, together with every trace of metastasis, thoroughly excised.

Tumors of the Neck.

- Benign solid tumors: Fibroma, Lipoma, Enchondroma, Osteoma, Neuro-fibroma, Adenoma.
- Cystic tumors: Sebaceous cyst, Accessory thyroid cyst, Blood-cysts: aneurysm, { congenital blood-cyst, and acquired " angeioma. Cysts of bursæ, Congenital cysts, Blood-cysts, Branchiogenic cysts: Dermoid, Atheroma, Air-cyst. Lymphangioma (congenital cystic hygroma).
- Malignant tumors: Epithelioma, Sarcoma, Carcinoma.

BENIGN SOLID TUMORS OF THE NECK.

Almost every variety of tumor has been found in the neck. Space only allows the following brief summary:

FIBROMA.—There is a slowly-growing, fibrous tumor which originates in the fibrous structures of the neck, such as the ligamentum nuchæ and the ligaments attached to the spinous and transverse processes of the vertebrae.

LIPOMA.—This may occur as a circumscribed, encapsulated mass with all the characteristics of a lipoma, or as a diffuse, ill-defined growth of fatty tissue, the removal of which would be difficult or impossible.

ENCHONDROMA AND OSTEOMA.—These may occur as congenital defects, being the remains of the so-called branchiogenic arches; or as an error in the development of the ribs or sternum; or they may arise later from any of the bony or cartilaginous parts of the neck or its vicinity.

NEURO-FIBROMA is rarely seen. A form of multiple neuroma—or, rather, neuro-fibroma—has been described as occurring with elephantiasis of the neck.

ADENOMA, arising from the subaceous glands, has been described, but is very rare.

Treatment.—The excision of these tumors may be more or less difficult according to their situation and connections with important structures. But they have no tendency to recur if thoroughly removed, nor do they cause metastases elsewhere.

BENIGN CYSTIC TUMORS OF THE NECK.

SEBACEOUS CYST is quite common, and presents no peculiarities in diagnosis or treatment.

ACCESSORY THYROID CYST may occur as described under the embryonic formation of the thyroid gland.

BLOOD-CYSTS are a rather numerous, but uncommon, class, except the aneurysms.

Aneurysms of almost every artery are possible. These are sufficiently described elsewhere.

Blood-cysts as a congenital defect occur usually as a result of malformation of one of the great veins of the neck. They present the characteristics of a uni- or multilocular cyst, filled with fluid blood, which may or may not communicate with the lumen of a vein through a larger or smaller opening. Rarely, the vein terminates in the cyst. If the latter is entirely shut off from the vessel, it will contain dark-colored fluid blood.

Acquired blood-cyst may arise later in life (and not as a congenital defect) as a varicose-like dilatation of the wall of the vein; or it may form a so-called cavernous tumor in which the septa of the tumor have gradually disappeared.

Symptoms.—If the cyst communicates with a vein, as it usually does, the contents may be squeezed out. But such a proceeding is not devoid of danger, owing to the possibility of detaching a clot if one is present. The walls become alternately tense and flaccid with expiration and inspiration.

The diagnosis can be settled by aspiration with a fine needle, using every antiseptic precaution.

Treatment.—Extirpation, with ligation of any vessels which may be found opening into the cyst. As these are apt to be the jugular or subclavian, the operation is not devoid of the dangers of entrance of air into the vein, hemorrhage, etc.

Angeioma.—The various forms of angeioma are quite common in this region, and should be mentioned under the general heading of Blood-cysts.

CYSTS OF BURSÆ.—These are sometimes called "hygromata," and are not to be confused with the congenital hygromata or lymphangiomata. The bursæ which are liable to exist and become distended are the following: The "*thyroid bursa*," lying on the front of the thyroid cartilage; the "*infrahyoid bursa*," lying just below the body of the hyoid bone, between it and the indentation in the anterior portion of the upper border of the thyroid cartilage; the "*suprahyoid bursa*," lying on the upper border of the hyoid bone.

The **diagnosis** is made by the location and by the fact that it is a cyst. The contents are a serous fluid. If it becomes infected in any way, it may, of course, suppurate. These cysts are of slow growth and usually give no trouble.

Treatment consists in thorough extirpation of the sac, or they may be aspirated. But in the latter case they will refill.

CONGENITAL CYSTS.—*Blood-cysts.*—These, either with or without communication with a vein, have already been described.

Branchiogenic cysts, sometimes called *hydrocele colli*, have also been described, with their serous contents. Under this heading of branchiogenic cysts come the *dermoid* and *atheromatous* cysts, from the inclusion in some one of the branchial clefts of epithelial tissues, which give rise to the contents, such as hair, bone, cartilage, cholesterin crystals, etc. These tumors may not be evident at birth, but may lie dormant till some unknown cause makes them become suddenly or slowly evident. Occasionally they attain a large size.

The best **treatment**, as has been said, consists in thorough extirpation. The serous cyst may be aspirated, but sooner or later it will refill. Unless the cyst becomes infected it generally causes little trouble, and with proper care aspirations may be practised as often as the cyst becomes distended.

Air-cysts.—Very rarely there has been observed a form of tumor which communicates with the larynx, trachea, or the apex of a lung. It is generally quite small. The sinus of Morgagni is said to become dilated in this way on one or both sides of the larynx, enough to be seen externally. A portion of the trachea is also said to have entered into such a tumor, which is, in all probability, of embryonic origin. Such an air-cyst or tumor may be acquired, appearing as the emphysematous apex of one or the other lung above the clavicle.

If any **treatment** is required beyond a bandage or other slight pressure, extirpation should present no special difficulties.

LYMPHANGIOMA has been observed in the neck, and is sometimes called "congenital cystic hygroma." It consists of an overgrowth of the lymphatics, accompanied by cystic degeneration. In rare cases a similar condition exists in later life and is not congenital.

This disease forms a lobulated, multilocular tumor, usually congenital in origin, sometimes becoming of large size, with perhaps fluctuation present in one part and not in another. Its most common site is the submaxillary region. It is apt to be ill-defined and intimately connected with the various important structures in the neck.

Treatment.—It can be completely removed only while it is yet small. A large lymphangioma generally cannot be entirely extirpated. In such a case an attempt may be made to cause cicatricial contraction

in the size of the cyst by multiple incisions or repeated injections into its substance of absolute alcohol, tincture of iodine, chloride of zinc, etc.

Malignant Tumors of the Neck.

Epithelioma may arise from any of the epithelial tissues in or about the neck, and be accompanied, as elsewhere, by an enlargement of the lymphatic glands.

Sarcoma.—In addition to the cases already mentioned of primary sarcoma of the lymph-glands, there are others in which this comparatively common malignant neoplasm occurs outside of the latter, starting from the fascia, connective tissue, or walls of the vessels. Its characteristics do not differ from those of similar neoplasms elsewhere, but, owing to its situation and the probable involvement of the important structures in the neck, the difficulty or impossibility of successfully removing it may be readily understood.

Carcinoma of the neck may start from the remains of a branchial cleft or from an accessory thyroid gland, as well as from any of the other structures in this region which are subject to cancerous disease.

In addition, almost any of the benign or cystic tumors already described as occurring in the neck may take on the character of a sarcoma or carcinoma, and so become malignant.

Treatment of malignant tumors of the neck does not differ from that of those occurring elsewhere. It consists in as early and thorough removal as possible, together with all the lymphatic glands in the neighborhood, whether they are visibly affected or not.

SURGICAL INJURIES AND DISEASES OF THE CHEST.

By FREDERICK S. DENNIS, M. D.

THE surgical injuries and diseases of the chest may be divided, for convenience of description, into lesions which affect the external thoracic walls, lesions which affect the contents of the thoracic cavity, and lesions which affect the mediastinum and diaphragm.

Lesions which affect the thoracic wall may be subdivided into injuries, diseases, and tumors.

Among the injuries may be mentioned contusions, wounds, inflammatory affections, fractures, and dislocations.

Contusions of the chest-wall are usually the result of direct violence, as a blow or a fall upon the chest. When the contusion is unaccompanied by any visceral complication or by fracture of the bony parietes or injury of blood-vessels, the lesion is not serious. The contusion is attended by a certain amount of swelling, ecchymosis, and pain. There is often difficulty in the repair of the wound, owing to the fact that the injured part is subject to a certain amount of motion incident to respiration. In some cases the pectoral muscle is torn from its insertion and the muscle is at once rendered useless and a large hæmatoma results.

The **treatment** of contusions of the chest-wall consists in the administration of some form of opium to reduce the number of respirations, the application of hot fomentations to control the pain, and, subsequently, the use of a broad strip of adhesive plaster in the manner described in the treatment of fracture of the rib.

In addition to ordinary contusions of the chest-wall, a variety has been described under the name of "commotio thoracica." This injury is analogous to contusion of the brain, and when fatal the cause of death is a sudden fall of blood-pressure. Post-mortem examination has failed to reveal any tangible lesion to account for the sudden death.

The **signs and symptoms** are those of profound shock, and the **treatment** consists in the administration of cardiac stimulants and, in extreme cases, the performance of artificial respiration. The patient should be placed horizontally and the head lowered to overcome the cerebral anæmia.

Wounds of the chest-wall may result from a gunshot injury or a stab, and may be non-penetrating or penetrating. (For a full description the reader is referred to the article on Gunshot Wounds, Vol. I., p. 495.)

Abscess of the chest-wall may be the result of contusion, of rupture of the pectoral muscle, or of caries of the rib or sternum. On account of the extravasation of the pus by gravity, fluctuation cannot always be detected.

The **treatment** of abscess of the chest-wall consists of an early opening by free incision, disinfection of the abscess, and the application of an antiseptic dressing. If the bone is diseased, it must be scraped or removed. During the repair of the abscess some means should be employed to control the respiratory movements, thus aiding nature in restoring the part to its normal condition.

Phlegmonous inflammations are sometimes observed upon the thoracic wall. They take their origin from the loose connective tissue found under the muscles over the scapula, under the pectoral muscles, or in the axilla. They develop very rapidly, cause severe toxic symptoms, and produce great nervous depression. In the axilla the phlegmon has a peculiar honeycombed condition, and the abscess is divided into many small cavities.

The **treatment** should be prompt, radical, and antiseptic. Free incisions, and, in case of the axillary phlegmon, several incisions, so as to open up all the cavities, are indicated. The use of the curette is often of great advantage, and drainage must be employed for some time. In making the deep incisions care must be exercised lest some important vessels may be wounded, especially in the axillary space.

Furuncle and *carbuncle* are often seen upon the thoracic parietes. They show a special predilection for the back in the vicinity of the vertebral column, and often present a most violent form of inflammation, giving rise to severe septic infection, and are attended by extensive sloughing. If the patient is over sixty years of age, the prognosis is most unfavorable. The gangrene is often so deep and widespread as to expose the spinous processes of the vertebræ. Carbuncle is often met with in diabetes, and in cases in which this disease is absent sugar is found in the urine.

The **treatment** of furuncle and carbuncle must be conducted on strict antiseptic principles. If the parts are tense and pus is present, free and deep incisions should be made in several directions and then the wound dressed antiseptically. This operation must be performed under the influence of an anæsthetic, since the pain is very severe. The patient's strength must be maintained by an abundant and nutritious diet and by free stimulation. The free use of quinine is indicated, and also anodynes to relieve the pain and induce sleep. Incisions should be avoided when the circumstances permit, since sloughing is often increased by the operation.

The lymphatic or cold abscess is often situated upon the thoracic parietes in cases of skin tuberculosis and scurvy in which no bone disease is present. There have been reported some thirty cases of this variety of abscess, in a few of which recovery has taken place, but in many of which general tuberculosis followed the incision and the patients rapidly sank and died. These abscesses should be aspirated and injected with a solution of iodoform and glycerin, or else laid freely open and thoroughly disinfected with bichloride-of-mercury solution, after which the wound should be dressed with iodoform powder.

Fractures and *dislocations* of the bones and joints which form the chest-wall are fully described in the general article upon Fractures and Dislocations.

The diseases of the bones forming the chest-wall consist of *caries* and

necrosis, periostitis and osteomyelitis of the ribs and sternum, also chondritis and perichondritis. These pathological conditions arise from injury, syphilis, tuberculosis, scurvy, and certain infective fevers, and are usually accompanied by sinuses which are often tortuous. Caries of the ribs has been observed during the convalescence from typhoid fever. The origin of the caries was from a periostitis, in which the typhoid bacillus was found to be the cause of the infection.

The **treatment** consists in opening up the sinus down to the diseased bone, scraping the sinus and the bone, and packing the wound with iodoform gauze in order to allow it to heal from the bottom.

Tumors which affect the chest-wall may be benign or malignant. They include lipoma, fibroma, sarcoma, carcinoma, chondroma, and osteoma. They may have their origin from the soft parts or from the bones or cartilages, or they may even be intrathoracic and yet present externally.

It is often difficult to determine the origin of thoracic tumors. They should be carefully studied before attempting any surgical interference. The benign growth that is frequently found on the chest-wall is a lipoma which grows from the subcutaneous fatty tissue and attains a moderate size. The tumor is freely movable under the skin, which is wrinkled over it, gives rise to no pain, grows slowly, and is usually more or less pedunculated.

The **treatment** consists of excision of the neoplasm. Langenbeck has pointed out the fact that a lipoma may have its origin within the cavity of the chest, and in such case its removal may be attended with great danger.

Cysts found upon the thorax grow from the connective tissue or may have their origin in the connective tissue of the pleura. Langenbeck once removed a cyst of this description by resecting a portion of three ribs.

Enchondroma grows at times very slowly, and is unaccompanied by pain, or, on the other hand, may grow with great rapidity and be attended with severe pain. The latter variety calls for surgical interference, and this consists in removal by flap incision, with resection of attached ribs. The former variety is harmless, and is so small and grows so very slowly that the risks of operation are greater than the presence of the tumor.

Sarcoma and *carcinoma* of the chest-wall appear in the form of very hard, indurated masses, usually located over the sternum and immovably connected with the subjacent structures. These tumors grow rapidly and soon cause marked cachexia. The skin becomes adherent to the tumor and is discolored, and subsequently ulcerates and gives rise to hemorrhages. It is impossible to determine after the growth has attained any size whether it has its origin from the cavity of the thorax, having caused erosion of the sternum, or from the periosteum of the bone externally. The treatment has for its object the removal by excision of all the soft tissues down to the bone, which should be freely scraped and cauterized by Paquelin's cautery. If ether is employed, great care should be exercised lest the ether becomes ignited at the mouth of the patient during respiration, producing a flame which burns the patient fatally.

The **prognosis** is most unfavorable in sarcoma and carcinoma of the

chest-wall, especially if they have an intrathoracic origin. There have been, however, some cases reported in which freedom from the disease persisted for many years after the operation, giving every prospect of a permanent cure.

Lesions which Affect the Contents of the Thoracic Cavity.—Hydrothorax, hæmothorax, and pyothorax will be considered together, since the operative technique is practically the same.

The **surgical treatment** of these affections varies according to the character of the fluid, and consists of thoracentesis, thoracotomy, and thoracoplasty.

Thoracentesis is an operation to withdraw fluid from the pleural cavity by the introduction of an aspirating needle, a trocar and cannula, or a special instrument called an aspirator. As a rule, thoracentesis should be employed in preference to other operations unless the diagnosis of pus is absolutely certain, since Ashhurst has shown that if a mistake in diagnosis has been made, the risk attending thoracentesis is much less than that of thoracotomy or thoracoplasty.

The **signs and symptoms** of effusion into the pleural cavity vary somewhat according to the nature of the causative affection and the character of the fluid.

Acute hydrothorax may be due either to acute pleurisy with effusion, or it may be secondary to circulatory changes following disease of the heart, kidneys, etc. In the latter case it is a simple transudation, and is, as a rule, bilateral.

The following physical signs are common to both varieties of the affection: The intercostal spaces on the affected side are obliterated or may even bulge outward. In inspiration the affected side expands to a less extent than the sound side, and there is often absolute fixation. On percussion there is dulness or flatness over the affected area; this dulness is movable, the upper limit being higher or lower according to the position of the patient. The percussion-note just above the upper limit of dulness is often tympanitic, to which fact Skoda has called attention. On auscultation the respiratory murmur is enfeebled as compared with that heard over the opposite side. When the layer of fluid is thin the breath-sounds may have a distinctly tubular quality, suggesting consolidation rather than effusion; the voice-sounds are distant over the dull area, sometimes having a bleating quality. Vocal fremitus is diminished, in most cases being imperceptible. There is lateral displacement of the apex-impulse of the heart; this is most readily made out in right-sided effusion. If the effusion be large, there may be displacement downward of the abdominal viscera. Adhesions may form between the two pleuræ, giving rise to circumscribed, sacculated, or encapsulated effusions. In cases of long standing there may be great thickening and adhesions of the pleuræ, so that, while the effusion may be reabsorbed, the thickened pleura may give rise to many of the physical signs of effusion and lead to a faulty diagnosis. In such cases a preliminary exploratory puncture with a hypodermic needle is absolutely essential.

Where the effusion is purulent most of the physical signs given above are to be made out. The temperature curve is septic in nature, however; there are chills and sweats and more or less cachexia. If the disease be of long standing, there are retraction and compression of the lung

on the affected side, with deformity of the chest-wall. This latter may be very great in cases of long standing and in children.

Thoracentesis is indicated when the fluid collected in the pleural cavity is sufficient to embarrass the patient's breathing. In addition, it happens occasionally that tapping is indicated when the fluid has not disappeared under proper medical treatment. In performing this operation strict attention must be given to antiseptic detail to prevent a simple sterile effusion from being converted into an empyema.

The operation should be employed as soon as enough fluid has accumulated to cause dyspnœa, since under the circumstances of an early operation the lung is more likely to fully expand, the chest-wall to contract, and the altered relations of the lung, pleura, and chest-wall to become normal. Early thoracentesis also prevents permanent adhesions of the pleura. In children thoracentesis will often effect a cure, since the fluid is due to the presence of the pneumococcus, while in adults the fluid usually contains two or more kinds of pyogenic organisms, and the prognosis is not so favorable. In children no irrigation is indicated. In adults, if tubercle bacilli with no bacteria of suppuration are found in the exudation withdrawn by a hypodermic needle, aspiration is indicated.

In washing out the chest after aspiration the surgeon should be careful not to chill the pleural surface by injecting into the cavity a cold solution. Hemiplegia has been caused by this treatment in several cases. There have been many theories offered to explain this distressing accident. One theory is that the hemiplegia is due to a cerebral embolus formed by detachment from a venous thrombus—a theory which was soon found to be erroneous, since in the fatal cases no embolus was discovered. Another theory is that the hemiplegia is reflex in character, and is caused by some inhibitory action of one-half of the cerebrum—a theory not tenable, because the pleural surface is insensitive, since it is changed into the wall of an abscess-cavity.

Another theory is that the hemiplegia is epileptiform or uræmic or toxic in character, or even due to poisoning by the antiseptic solution. All of these theories are practically abandoned in favor of surgical shock, which seems to offer the best explanation in the majority of cases. It should, however, be stated that occasionally the paralysis is on the side opposite to the empyema. This of course destroys the force of the argument that surgical shock is the only cause of the hemiplegia.

Before introducing the needle the field of operation and the instruments should be made thoroughly aseptic. This is a most important preliminary step, since in cases where pus is not present infection may be carried into the pleural cavity. The skin over the chest and in the axilla should be washed and scrubbed, and disinfected with a solution of bichloride of mercury or carbolic acid. The needle and tubing should be boiled, and then immersed and kept for some time prior to the operation in an antiseptic solution. The aspirator itself should be flushed with an antiseptic solution. The patient should have a rubber cloth placed over the chest-wall, upon which dry sterilized towels are laid, and over these wet bichloride towels, so as to prevent any possible infection. The use of the rubber is necessary, since the local application of

wet towels directly to the surface of the chest has caused an increase of the acute pleurisy. This precaution is necessary in all operations where wet towels are employed, to protect the patient from infection during a surgical operation. The surgeon, assistant, and nurse should thoroughly disinfect their hands and otherwise prepare for an aseptic operation. Anæsthesia is not necessary in aspiration of the chest, since the employment of the ether spray, notably the chloride of ethyl, for a few moments, in addition to, if necessary, the subsequent injection of a solution of cocaine, will render the operation painless. In cases where anæsthesia is required on account of a more radical operation the selection of the safest anæsthetic must be carefully considered, and it must be made in accordance with the specific rules given in the article upon anæsthesia.

Before and during the operation some stimulants should be administered, as there is always a tendency to cardiac syncope. The patient can usually sit half upright and be supported by pillows, and this position is the most convenient for the surgeon and at the same time favors drainage by gravity. After the fluid is beginning to flow the pillows can be removed and the patient allowed to recline on the bed. During the operation great care should be exercised, lest entrance of air takes place or lest any injury be inflicted upon the viscera or important structures. The fluid must not be withdrawn too rapidly or in too great quantities at one sitting, since the relief afforded to the heart is attended with serious disturbance, and sudden expansion of the lung after long-continued compression is attended with great distress and danger.

Coughing and a sense of oppression, with a notable change in the pulse, are indications to stop the flow of the fluid, since these indicate a too rapid expansion of lung and a forcible tearing up of adhesions. The parts should gradually accommodate themselves to the vacuum caused by the removal of the fluid. Pus is forced out of the pleural cavity not so much by gravity, as in the case of the ordinary abscess, as by re-expansion of the lung and the ascent of the diaphragm.

Having taken these preliminary measures, which are necessary in operations upon the chest to secure the safety of the patient, the surgeon is now ready to perform aspiration. The point of election is either the eighth intercostal space near the angle of the scapula (Fig. 43) or the sixth intercostal space in the mid-axillary line just in front of the border of the latissimus dorsi muscle, or at a point where the dulness is most marked and the bulging of the intercostal space most conspicuous. A small puncture through the skin with a sharp scalpel often renders the introduction of the needle less annoying to the patient. The integument is now drawn upward to form a valve-like opening, and the needle thrust in above the upper border of the lower rib at the numerically selected intercostal space. A Dieulafoy, a Potain, or an ordinary aspirator should be employed if accessible; if not, Bowditch's suction trocar or a needle with a tube may be used. The free end of the tube should be immersed in an antiseptic solution, so that the fluid from the chest may be evacuated under fluid to prevent the entrance of air. If the patient suffers from spasmodic coughing during the operation, it is an indication to arrest the flow and wait a few moments to see if coughing persists before proceeding any further. If the fluid sud-

denly stops flowing, it is due to the presence of a plug of fibrin or lymph or caseous pus in the needle, and this can be removed by the introduction of a stylet or by the attachment of the end of a tube from an irrigator to wash back with antiseptic fluid the plug into the chest. The gradual cessation of the flow indicates the fact that the fluid has

FIG. 43.

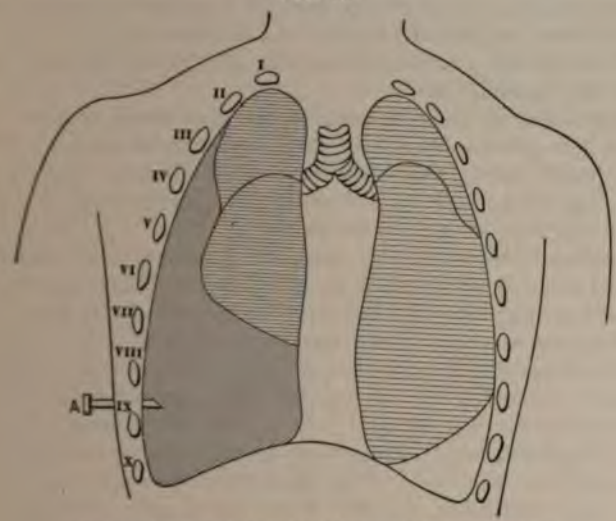


Diagram showing point (A) at which to tap an empyema.

been emptied from the pleural cavity. The proper quantity to be withdrawn is influenced by the character of the fluid, its amount, and the condition of the patient. If a large quantity is present, not more than half should be taken away at one sitting, and this very slowly. The condition of the patient's pulse and respiration should be carefully watched, and upon the first appearance of any change measures should be immediately instituted to stop the flow and to judiciously stimulate the patient in the recumbent position. The patient should remain perfectly quiet after the tapping, and the wound be hermetically sealed with iodoform and styptic collodion. The fluid may reaccumulate, in which case thoracentesis is to be repeated, since several tappings may be necessary to ensure a cure. It occasionally happens that a small sinus may develop in consequence of tapping, but this condition gives rise to little disturbance, and usually the sinus closes as the patient's general health improves. If the serous discharge should for any reason become purulent, the indications are present for free incision and drainage, the technique of which is described under Thoracotomy.

Much valuable information may be gained by examination of the fluid withdrawn from the chest.

In acute hydrothorax due to pleurisy the effusion is usually a clear serous fluid, straw-yellow in color. It contains albumin, and shows a few red and white blood-corpuscles and epithelial cells. The determination of the specific gravity is of value in the differentiation between

inflammatory effusions and simple transudations. It is high in the former (1020) and low in the latter (1010).

A hemorrhagic effusion points to tuberculosis or cancer. In some cases of pleural neoplasm cancer-cells may be found in the effusion. It must not be forgotten that the effusion in tuberculosis is often purely serous in character, identical with that usually seen in acute pleurisy. A purulent effusion is, as a rule, readily recognizable with the naked eye. Where the pus-cells are relatively few in number microscopical examination will be of value. Chemical examination of the fluid furnishes little information of value in diagnosis, except as regards a possible wound of the thoracic duct.

The bacteriological examination, on the other hand, is most important, and, where it is possible, cultures should always be made. The micro-organisms found most frequently in pleural effusions are the so-called pus-producing cocci, the pneumococcus, and the tubercle bacillus. The simple transudations are of course sterile.

The cultures from tubercular cases are almost always sterile, because of the small number of bacilli present. The only sure test is the inoculation of guinea-pigs with a considerable quantity of the fluid. In those cases coming on insidiously, where the fluid is purulent and cultures from it are negative, the case is probably tuberculous. The prognosis of operations in such cases is less favorable, as a fistula often results. Those cases of empyema proved to be due to the pneumococcus furnish the best prognosis, while those due to the pus-producing organisms occupy a medium position. The fluid from a wound of the thoracic duct has been mistaken for the fluid in a case of empyema. A chemical analysis will correct the diagnosis.

Thoracotomy consists in making free incision in the chest-wall for the purpose of evacuating fluid contained in the pleural cavity. It may also be a preliminary step to washing out the sac with an antiseptic solution and establishing free continuous drainage with antiseptic irrigation. A spontaneous opening sometimes takes place in front, about the third interspace, a few inches from the sternum. If a hypodermic syringe has been used and the fluid from the pleural cavity reveals the presence of bacteria of suppuration, a thoracotomy, with possibly a resection of a piece of rib, is indicated.

Before beginning thoracotomy the field of operation should be rendered thoroughly aseptic, as well as the instruments and the surgeon's hands. The application of local anæthesia, as already described, and the administration of stimulants are necessary. In some cases general anæsthesia is indicated for the proper performance of this operation. The point of election is upon the side of the chest just in front of the latissimus dorsi muscle and through the sixth or eighth intercostal space. Godlee recommends a point corresponding to the ninth rib and a little external to the angle of the scapula. Hewson suggests the eighth intercostal space slightly posterior to the scapular line, in order to avoid the diaphragm, an injury of which is attended with most serious consequences. Stokes believes the eighth intercostal space even too low, since no argument adduced from experimentation on the cadaver can be adopted as a rule for guidance in operating upon the living subject. It is not

essential to select the lowest part of the cavity, because the diaphragm will rise after the pressure of the fluid is removed.

The integument should be drawn upward, so as to form a valve-like opening, and an incision about two inches in length made in the tense skin between the ribs. When the parts are divided down to the pleura and all hemorrhage is arrested, a hypodermic needle can be introduced into the pleural cavity in order to make the diagnosis absolutely certain. If pus is present, the pleura can be incised nearly the length of the outer incision, and the pus will flow freely out of the opening. If the pus is especially foul and contains clots, the cavity can be irrigated with a bichloride solution 1:10,000, followed immediately by ablution with warm distilled or boiled water. Offensive pus indicates an unfavorable prognosis. Flushing the pleural cavity after thoracotomy must be conducted with great care, since sudden deaths, as has already been mentioned, have followed this procedure. In some cases a parenchymatous hemorrhage has been established, owing to the sudden withdrawal of intrathoracic pressure, and the blood-clots thus formed may cause sepsis. During irrigation the position of the patient should be changed in order to permit the antiseptic solution to permeate into every corner of the abscess-cavity. A rubber drainage-tube with no lateral openings, or, better, since the soft tube is often compressed by the ribs, a silver cannula shaped like a tracheotomy-tube with a broad flange, can be inserted and held *in situ* by some mechanical means (Figs. 44, 45). In this way the chest can be irrigated daily if necessary.

FIG. 44.

FIG. 45.

In free incision air enters the pleural cavity and prevents the lung from expanding too rapidly, since there is atmospheric pressure upon both sides. Beck suggests a resection of a piece of rib to permit the surgeon's finger to explore the cavity, in order to remove any lumps of fibrinous exudation, and by this procedure the surgeon can determine the size of the cavity. Ashhurst suggests the use of a lithotomy staff to make a double opening for drainage. After the fluid has been evacuated and the cavity washed out, some antiseptic gauze can be applied to the chest and to the mouth of the tube, and over this some absorbent cotton and a piece of rubber cloth or protective to hold the discharge until the subsequent dressing. The tube should not be removed until the discharge is very slight and serous in character. Weeks recommends in certain cases the use of sterilized gauze to act as drainage, especially in children. Too early closure of the chest-wound often leads to the disagreeable necessity of a second operation. In tubercular empyema free incision and drainage are to be preferred to aspiration, because

aspiration permits of a too sudden re-expansion of the lung, which is apt to cause severe paroxysms of coughing and to tear up adhesions too rapidly, and thus establish a pneumothorax or even cause a profuse hæmoptysis. Aspiration is indicated in children and in adults where the origin of the trouble is not tubercular. Parke suggests the cauterization of the abscess-cavity with a 50 per cent. solution of chloride of zinc.

Free incision and thorough drainage in an empyema of tuberculous origin allow the entrance of a certain amount of air into the chest, which enables the lung to expand slowly and gradually.

In cases of effusion the heart is displaced, and by suddenly withdrawing all the fluid at one operation the action becomes seriously embarrassed. After the operation and during convalescence pulmonary gymnastics are of great service. One of the best means of helping nature to expand the lung is accomplished by the use of two large Woulff's bottles, one of which is filled with water and the other empty. The patient is to blow the fluid from one bottle into the other. In children the water can be colored, and the act of blowing the stained fluid from one bottle into the other affords a certain amount of amusement. Such exercise has a remarkable influence in bringing about re-expansion of the compressed lung, and should be employed in every case.

Thoracoplasty is indicated when thoracotomy has failed to relieve the empyema because the lung is unable to expand or the chest-wall to contract—two conditions which prevent a permanent cure—or when a new sacculated empyema has developed or a spontaneous rupture has occurred with a fistula, which at times discharges freely and then again is closed. In cases where an empyema is of long duration and the lung is unable to expand, and the patient's general condition is fairly good, some surgeons recommend in lieu of thoracoplasty the Playfair-Bulau method of slow aspiration-drainage, as offering to the patient the benefits of the best method of treatment as contrasted with the formidable operation of Estlander. Thoracoplasty is also indicated on account of the remote effects of purulent effusions upon the brain, kidney, lungs, and other organs, as well as on account of the establishment of general tuberculosis. In these cases the lung is fixed and cannot expand, the pleura is adherent and inelastic, the chest is prevented from collapsing, and thus a cavity is permanently formed the obliteration of which is necessary in order to effect a cure. For relief of this intractable and dangerous condition Estlander has devised an operation which has for its object the obliteration of the abscess-cavity. This operation was first suggested by Dr. Warren Stone of New Orleans, but the credit of establishing it as a recognized procedure is due to Estlander. It is a serious one, and is only undertaken to save life, and the mortality depends upon the size of the cavity, the character of the empyema, and the general condition of the patient. Anæsthesia of course must be employed, and a careful examination of the lungs, heart, and kidneys should be made before deciding as to the choice of the anæsthetic. In giving the anæsthetic the patient should not be placed too much on the sound side, since the narcosis, with the carbonic-acid poisoning, might cause too much shock, or the pus might get into the bronchi of the sound lung and establish a circumscribed suppurative pneumonitis.

Before the ribs are exsected the finger should be introduced into the

cavity in order to ascertain its dimensions, with a view to determine the shape of the flap, the direction of the incision, and the extent of bone to be removed corresponding with the cavity which is generally found in the upper or middle part of the chest and seldom in the lower part. In accordance with the anatomical situation of the cavity, the ribs from the second to the seventh are generally selected. The first rib should not be touched, on account of its proximity to the subclavian vessels. The amount of bone excised depends again upon the size of the cavity, and may consist of less than an inch, or involve practically nearly the entire osseous structure of the rib overlying the abscess-cavity. The ribs can be exposed either by dissecting a large flap shaped like the letter U, with its pedicle upward, which is attended with considerable hemorrhage, as suggested by Godlee; or by transverse cuts along the centre of each intercostal space, with excision of the upper and lower ribs in the wound, as recommended by Estlander; or by several small flaps, as advised by Jacobson; or by a vertical incision over the mesial line of the cavity, as described by Gould. Whichever plan is adopted, as soon as each rib is exposed the periosteum is separated from it and each rib excised, with the subsequent removal of the corresponding periosteum. If the sac extends toward the spine, Gould suggests removing the anterior part of the rib, and then the posterior part from within the cavity of the chest. The thickened pleura must now be cut away, and all hemorrhage immediately arrested by the use of forceps and ligatures. Schede has suggested the resection of all the tissues of the wall, and then approximating the skin and superficial fascia to the pleura. Tillmanns suggests the application of the curette to the pleura after resection of the ribs. The hot bichloride irrigation is often valuable in controlling the oozing from the diseased pleura. After the antiseptic irrigation, warm distilled water should be used to counteract any dangers arising from bichloride-poisoning. The wound should be closed by suturing the flap or incision, leaving in the chest a good-sized drainage-tube. The patient usually suffers from severe shock, and every precaution should be taken to operate as quickly as is consistent with thoroughness, and every measure to resuscitate the patient after the operation should be in readiness, so that no time is lost in administering stimulants.

Whatever operation is performed upon the chest to withdraw fluid from the pleural cavity, the conditions of rigid asepsis must be continued, even though the fistula discharges but a slight amount of purulent matter, since acute infection may become established through the fistulous opening and the patient's life placed in great jeopardy. As long as a serous discharge exists great care should be exercised lest a new fire may be kindled by external infection. Dressing, therefore, should be made with every precaution to prevent this disaster.

Thoracoplasty is indicated instead of thoracotomy in cases where an empyema has been present several months. This period of time causes the lung-tissue and the thoracic parietes to lose their normal elasticity, and the pleura itself to become greatly thickened and infiltrated, and at the same time the seat of deposit of granulation-tissue with jelly-like coagulable lymph. Under such conditions incision and drainage are of no avail, and Estlander's operation holds out to the patient the only hope of future safety.

Pneumotomy is the operation of incision into the lung for the purpose of draining a cavity or removing a foreign body. The cavity having been previously mapped out with great care and accuracy by means of exploratory puncture, auscultation, and percussion, and having ascertained the condition of the lungs, heart, and kidneys, and every antiseptic precaution having been taken as regards the patient, instruments, and the operator and assistants, the surgeon is ready to begin his work.

Chloroform is considered by most surgeons as preferable to ether, since the latter is likely to cause paroxysms of coughing and vomiting, although ether may in exceptional cases be indicated. The incision

FIG. 46.

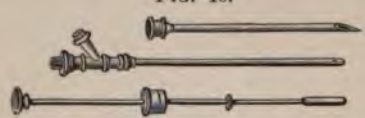


FIG. 47.

is made over the site of the cavity while the patient lies upon his back. The incision should extend through all the tissues down to the intercostal space, and, if necessary, an aspirating needle can be employed to act as a guide (Figs. 46, 47). A good-sized trocar with cannula is now pushed through the soft tissues, then through the pleura, and finally into the lung. The exit of pus indicates that the cavity has been reached. The discharge is now allowed to flow out of the cannula, and the cavity thoroughly washed out with an antiseptic solution. A drainage-tube should now be carried into the bottom of the cavity, or, if necessary, through a counter-opening. The tube can be passed through the cannula or else through the canal, which can be enlarged by forceps, so that the finger can be introduced with a view to explore the parts, and a tube afterward introduced into this canal. When the lung is not fixed by adhesions and the pleural cavity is not closed at the site of operation, Godlee has suggested to stitch the lung to the side of the chest-wall, which is a most difficult procedure. The operation is now finished, and is not to be again resumed for several days until adhesions have formed, when with a sharp-pointed bistoury or by the cautery the cavity can be safely reached. Stitching the lung to the chest-wall is a most difficult task, on account of the small opening in which the surgeon is obliged to work, and also because the lung is constantly in motion, and, finally, because the pulmonary tissue is so fragile that the sutures are apt to constantly tear their way through the lung-structure. If pus should get into the pleural cavity, an empyema will result, and operative interference for relief of that condition is immediately indicated.

The results of pneumotomy are very encouraging, considering the gravity of the condition and the lack of exact knowledge in the technique of the operation. There have been some fifteen cases of pneumotomy reported in detail, and many others have been done of which no public report has been made. While it is possible for abscess of the lung to recover, gangrene is almost universally fatal, and for the relief of this condition pneumotomy can achieve some brilliant results. As surgical technique improves and diagnosis is more certain, pneu-

motomy holds out a chance of recovery in these cases, which hitherto were considered almost invariably fatal.

Pneumotomy is also indicated in gangrene of the lung caused by some form of traumatism, as a stab- or gunshot-wound, by severe injury to the thoracic wall, or by the presence of foreign bodies in the bronchi or lung. The condition may also arise from mechanical pressure causing arrest of blood-supply and hence loss of nutrition to the part, by an infected embolus, or by septic poison derived from a broken-down tuberculous abscess or a bronchiectatic cavity. It may also arise during the progress of certain diseases like pneumonia or diabetes.

There have been some successful cases of pneumotomy for the relief of gangrene of the lung, and this operation has thus offered to suffering humanity a chance of cure in cases where heretofore no hope of recovery could be entertained.

Pneumotomy, again, may be indicated in *abscess of the lung*, which may be a termination of pneumonia or a circumscribed suppurative inflammation of the lung or a result of gangrene of the lung. Abscess may also arise from the presence of a foreign body which has become lodged in a bronchial tube or even in the lung-structure, as in a gunshot-wound or traumatism from a fractured rib. Abscess of the lung may be due to the effect of the presence of a septic embolus carried to the lung by various channels in communication with an infected thrombus in the brain-sinuses or elsewhere, which is situated in a wound upon the body, or from a bed-sore, from the uterine sinuses, from ulcerative endocarditis, or from an otitis media. The abscess may also result from a suppurative process in chronic phthisis. In all of these abscesses of the lung septic micrococci are found in the purulent discharge.

The **diagnosis** of abscess of the lung is made by the application of the rules which govern the surgeon in detecting abscesses in other parts of the body. The physical signs are—limited area of dulness, abnormal changes in the respiratory murmur, increase of the vocal resonance and fremitus, and bronchial whisper.

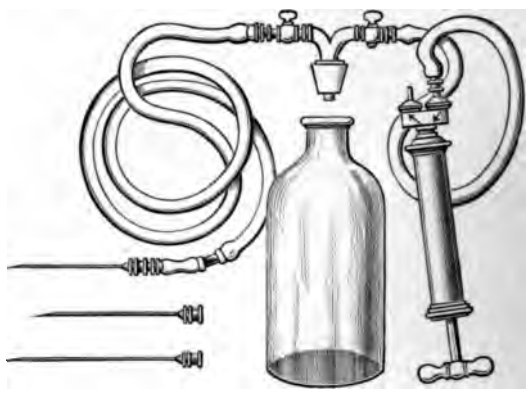
If there is expectoration of sputum, the character of it is pathognomonic. The pus is very offensive and is of greenish or brown color. Under the microscope shreds of lung-tissue are found, also crystals of fat and hæmatoidin, and elastic fibres with pigment. The absence of the bacilli of tuberculosis renders the diagnosis approximately certain as to its non-tubercular character.

The constitutional symptoms are such as would be found when pus is forming in any other place in the body. If there is no fistula to permit exit of the sputum, Fenger suggests the introduction of an aspirating needle into the lung over the site of the abscess. In this case everything should be aseptic. The needle can be introduced through an intercostal space into the lung at a point where the physical examination has demonstrated the site of the abscess. If the point of the exploring needle enter the cavity, there is a loss of resistance and the point is freely movable in a circumscribed cavity, just as in introducing a needle into an abscess situated in any other part of the body. At the other end of the needle a tube and an aspirator should be attached for the purpose of aspiration (Fig. 48). If pus is found, the diagnosis is confirmed. In these cases the pleura is usually adherent to the lung

and chest-wall, which renders the operation of puncture safe. In case the pleura is not adherent, the use of the needle is fraught with danger, since its withdrawal might infect the pleural cavity and establish an empyema.

Pneumotomy, finally, may be indicated for the relief of hydatid cyst, which is a surgical disease that may affect the thoracic cavity. In 2137

FIG. 48.



cases of echinococcus reported by writers, 212, or about 10 per cent. of the cases, affected this cavity. The most frequent seat within the thoracic cavity is in the lung. If the cysts in the lung are small, no symptoms are present indicative of the disease; but if the cysts are large, the symptoms denoting intrathoracic pressure are present. Hydatids of the pulmonary structures are liable to be mistaken for pleuritic effusions or lung-tuberculosis. In order to arrive at a positive diagnosis a microscopical examination should be made of the fluid, which is withdrawn by a hypodermic syringe having a large needle attached to it, and in the fluid the hooklets should be seen.

No reliance can be placed on the circumscribed and immovable dulness, as an encapsulated pleural exudation may present the same physical signs. If the cyst ruptures into the pleural cavity, an empyema is at once developed.

The **prognosis** in hydatid cyst of the lung is grave, since about 75 per cent. of the cases are fatal.

The **treatment** consists in non-interference until the cyst is large enough to cause serious symptoms. In many cases a cure has been effected by simply tapping the cyst, but several cases of sudden death have followed the procedure. In cases where tapping fails to relieve the patient, and the fluid becomes purulent, a pneumotomy is indicated. Echinococcus of the pleura cannot always be differentiated from that of the lung. These cysts also occur in the heart or in the mediastinum, in which case the treatment is symptomatic.

Pneumocele is a hernia of the lung. This condition is observed after stab-wounds of the thoracic wall. This variety of hernia has no peritoneal sac, as is the case in abdominal hernia, but often the prolapsed lung is covered by the pleura, which thus forms a serous sac for the

hernia. The presence of this serous sac depends upon whether the wound penetrates the tissues only down to the pleura, through which opening in the thoracic parietes the lung with the pleura protrudes, or through the pleura directly into the lung.

The accompanying illustration shows a pneumocele in which the patient was stabbed seven times, one of which wounds opened into the lower part of the thoracic cavity, and through the wound a good-sized hernia occurred. The patient was a captain, and a mutiny arose in which five of the officers and crew were killed. The mutineers, finding

FIG. 49.

Pneumocele following stab-wound of the thorax.

that they were overcome, set fire to the ship and jumped into the sea and perished. The captain with the surviving members of the crew escaped in a boat, and in seven days reached the island of St. Helena. The patient is still alive after his marvellous escape. The lung appears under the skin with all the characteristic signs of pneumocele.

Hemorrhage in these cases is most important. The blood may come from a wounded intercostal artery or from the lung-tissue. In the former case the blood spurts from the wound synchronous with the action of the heart, and the color is a bright red. In the latter case the blood oozes up from the wound and is dark in color. Richter, with a view to a differential diagnosis of the source of hemorrhage, has suggested pushing a folded card deep into the wound with the bent end upward. If the hemorrhage comes from an intercostal artery, the blood will flow out along the top of the card only, while if the blood proceeds from an injured lung, it will flow beneath and around the card.

Hemorrhage from an intercostal artery should be arrested by enlarging the wound and seizing both ends of the divided vessel and placing ligatures around them. If this is not possible, a finger-shaped tampon can be pushed in between the ribs and then packed in its interior, and drawn outward against the inner surface of the rib. If the bleeding still persists, excision of the rib must be performed or the periosteum of the rib enucleated from the lower half of the rib, and in this membrane the injured vessel can be seized and tied.

The **signs** of pneumocele consist of a tumor which has appeared suddenly as the result of traumatism and which is situated upon the thoracic parietes. The tumor appears during the act of expiration, is smooth to the feel, crepitates under the fingers, is dark in color, and expands during inspiration or coughing. If a stethoscope is placed over the hernia, the air can be heard to enter the tumor and percussion elicits a vesiculo-tympanic resonance. The pneumocele is usually reducible.

The **treatment** consists in the reduction of the hernia and the closure of the wound by sutures in the thoracic wall. The hernia seldom becomes strangulated, since there are no fibrous rings to constrict the neck of the hernial protrusions. The operation is generally indicated, as the prolapse is likely to increase in size and give rise to considerable discomfort.

Emphysema.—The escape of air from the lungs into the subjacent subcutaneous cellular tissue may occur with or without a wound of the pulmonary viscera. The extravasation of air becomes widespread by the action of the muscles, and may be so extensive as to make the patient unrecognizable. The air may even extravasate into the scrotum. The palms of the hand and soles of the feet, as well as the scalp, are parts of the body which are exempt. A fractured rib with a fragment penetrating the lung, or a gunshot- or stab-wound of the lung may cause an emphysema. This condition is readily recognized by the fine crackling sensation as the bubbles of air are forced along in the planes of cellular tissue.

Usually hæmoptysis is present in wounds of the lung in which emphysema is present. Emphysema may also occur in a wound of the pleura itself in which the lung is not involved. In this case the air is sucked from without into the pleural cavity during the respiratory acts of the patient, and, owing to the shape of the skin-wound, the air cannot escape. In this variety of emphysema a pneumothorax is present, the physical signs of which enable the surgeon to arrive at a partial diagnosis in conjunction with the absence of the physical signs of injury to the pulmonary tissue.

Emphysema may arise owing to a rupture of pulmonary air-vesicles at the apex of the lung in which the pleura is uninjured. This variety is caused by sudden forcible compression of the chest-cavity or even by external traumatism. The emphysema in this variety is situated chiefly in the neck. The air first escapes into the mediastinum, and from this cavity enters the root of the neck.

Traumatic emphysema must not be confounded with putrefactive emphysema, in which the formation of gas takes place in consequence of decomposition in a wound, or with intestinal emphysema, in which there is an escape of gas from a wounded intestine, or, finally, with that due to a valvular wound of the skin, in which the air is sucked into the subcutaneous tissues. In the traumatic variety the prognosis is not unfavorable, since the air soon absorbs. In exceptional cases only is incision into the skin indicated. If dyspnœa becomes great, this operative procedure is called for, and the escape of the air is followed by immediate relief. Erysipelas and death have followed simple incision to relieve traumatic emphysema, and if this operation is called for, it must be performed with every antiseptic precaution. In putrefactive

emphysema of the chest-wall the rigid application of antiseptics is called for in order to save the patient from the effects of sepsis.

In intestinal emphysema the escaping gas may ascend upward upon the thorax. The condition is one of great gravity and calls for an abdominal section, the details of which are fully described in the section on Abdominal Surgery.

The subcutaneous emphysema of the chest-wall caused by a valvular wound of the integument is of slight consequence, and is permanently relieved by enlarging the skin-wound in such a manner as to obliterate the valve and then irrigating the wound with some antiseptic solution. The application of an aseptic dressing will relieve the condition and prevent any further emphysema.

Rupture of the lung has been observed without a corresponding injury to the thoracic parietes. The lesion is a serious one, and is accompanied by pneumothorax, hæmothorax, hæmoptysis, emphysema, and, in some cases, empyema. Pleurisy and pneumonia have also been followed by this lesion. Gosselin has described the mechanism of rupture of the lung without accompanying parietal injury. He believes that at the time of the receipt of the injury the lung is fully distended and the glottis closed, so that under these conditions the lung is incapable of yielding and rupture follows. Ashhurst collected 39 cases of this peculiar injury, excluding gunshot injuries, with 12 recoveries, while Otis reported 25 cases, with 11 recoveries.

Surgical lesions of the heart and pericardium include ventricular distention, pericardial effusion, wounds, and diseases. A brief preliminary study of the topographical anatomy of these parts is essential in order to understand how to offer relief by surgical means. The heart is contained in a space which extends obliquely from the third to the sixth costal cartilage, and horizontally from half an inch to the right of the right border of the sternum to a point which is situated half an inch to the right of the left nipple. The heart is contained within a space between the fourth and eighth dorsal spines. The pulmonary artery lies in front of the left auricle, and the auricles are on a level with the third costal cartilage. The right ventricle occupies a space partly behind and partly to the left of the sternum. The left ventricle is covered entirely by the right ventricle except at its apex.

The pericardium is a fibro-serous sac in which the heart is found. The sac is shaped like a cone, with its base below and attached to the diaphragm, while its apex is above. The fibrous layer of the pericardium is connected with the deep fascia of the neck.

Paracentesis auriculi is indicated to relieve acute pulmonary congestion. In these cases the heart labors, so that the condition is often most dangerous. The point of election for tapping the heart-cavity is the right auricle, since its position to the surrounding parts is not likely to be altered, and also because the antero-posterior internal diameter is greater than that of the ventricle, whose walls are much thicker than the auricles. The point of election for puncture is the third intercostal space close to the right edge of the sternum (Fig. 50). The aspirating needle, rendered thoroughly aseptic, should be introduced directly backward, and a sufficient amount of blood withdrawn quickly by the suction force of an aspirator, because the blood-pressure here is not sufficient to

cause the blood to flow unaided through the cannula. The different structures through which the needle must pass to enter the right auricle are—skin, fascia, the periphery of the right lung with its pleural sac, and both layers of the pericardium.

Paracentesis pericardii is indicated to relieve over-distention of fluid within the sac, the result of acute or chronic pericarditis or in conse-

FIG. 50.

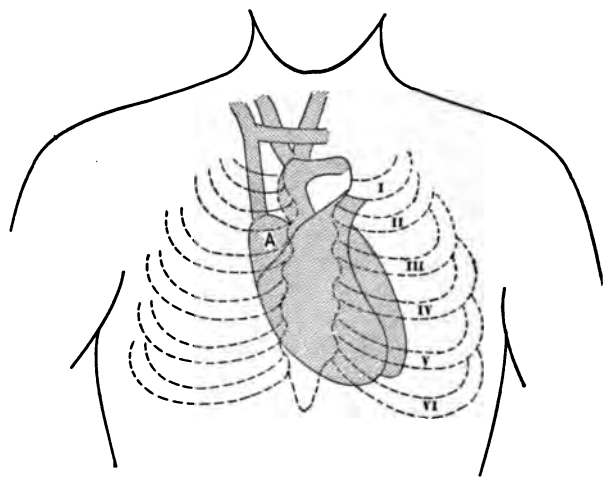


Diagram showing point (A) at which to tap the right auricle.

quence of injuries. The condition is similar to that observed in fluid contained in the pleural cavity. As a rule, the fluid is only moderate in quantity and becomes readily absorbed, but under exceptional circumstances the quantity of the fluid may be excessive and seriously embarrass the action of the heart.

The signs denoting distention of the pericardium with fluid are—pushing upward of the apex-beat, and in some cases the loss of the apex-beat, pericardial oppression, cardiac syncope, dyspnœa, feeble and irregular pulse, dysphagia, varicose enlargement of the cervical veins, in conjunction with the ordinary physical signs of pericarditis.

Pulsus paradoxicus is sometimes observed in cases of pericardial effusions. The peculiarity of this pulse is that the beat becomes very weak or even absent at every inspiration, and returns or becomes stronger at the beginning of the expiratory act. The right radial artery pulsates with greater force than the left. The left pupil is also said to be often larger than the right in pericardial effusions, while the superficial thoracic veins show evidences of engorgement, especially in the left infra-axillary veins. The feet are often œdematous, and the urine loaded with albumin, and often contains indican.

The pericardial friction-sound is present in the beginning of the attack of pericarditis, but as soon as fluid collects in sufficient quantity to separate the pericardial surface this sign is absent.

The pericardial friction-murmur must not be mistaken for an endocardial murmur, which has a regularity of rhythm and is limited to the

præcordia. Percussion reveals the presence of flatness over an area larger than the limits of the pericardium, and the area is triangular in shape. Auscultation reveals the presence of muffling of the heart-sounds and loss of vocal resonance and of fremitus.

Paracentesis pericardii is performed at the fifth intercostal space, two inches to the left of the left border of the sternum, so as to avoid wounding the internal mammary artery, which lies to the right of the puncture (Fig. 51). The needle should be thrust directly backward and the fluid

FIG. 51.

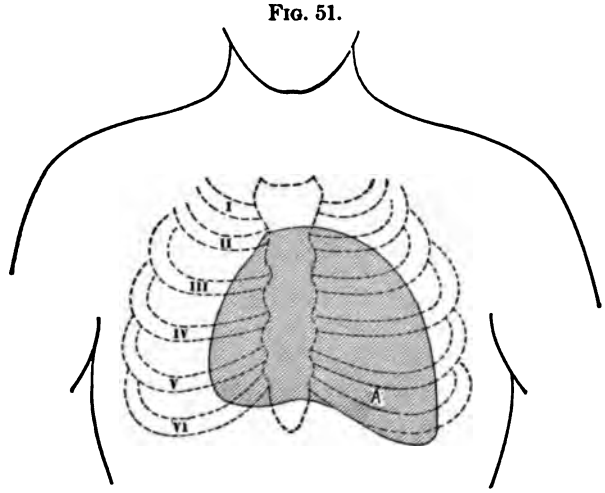


Diagram showing point (A) at which to tap a pericardial effusion.

allowed to escape very slowly, and the effects of withdrawal of the fluid carefully watched. In cases of empyema of the pericardium incision and drainage have been employed. The incision should be in the fifth intercostal space, and if necessary a piece of the rib can be resected. Some surgeons have advised irrigation of the sac; but this should only be done in exceptional cases, since the procedure is attended with some danger and the drainage usually is sufficient. Before aspiration or incision are performed, a small antiseptically clean hypodermic needle can be used in order to make the diagnosis positive. Strict aseptic rules should be observed in this operation. The results of surgical treatment are not altogether satisfactory; but the fact must be constantly borne in mind that these cases are exceedingly fatal without surgical interference. There have been reported 40 per cent. recovering after this operation, although many of the cases in the 40 per cent. were affected with other serious diseases (Roberts).

Foreign bodies have been observed in the pericardial sac. Their presence is due to an accident. The accompanying wood-cut shows a plate of false teeth (Fig. 52) lodged in the pericardium. The plate had been swallowed by accident during an attack of delirium tremens, and had ulcerated through the walls of the œsophgaus into the pericardium. The autopsy revealed the presence of the plate of teeth in the sac, which was filled with an effusion of serum and lymph.

Sands reported a case in which he removed from the pericardium a

paper cartridge. The patient had shot himself, and died a few days later from an attack of pericarditis. At the autopsy a square piece of brass cartridge-cylinder, $1\frac{5}{8}$ inches thick, was found imbedded in the lung. In 1876, Sands discussed the propriety of performing a pneumotomy for the relief of such conditions — an operation which has since been put successfully in practice. McDowell of Dublin reported also a case in which a small white body of a cartilaginous consistence was found loose in the pericardium. The precise nature of the foreign body is not stated in the published report.

FIG. 52.

Plate of false teeth which had been partially swallowed, and which subsequently ulcerated from the œsophagus into the pericardium (Wood Museum).

Rupture of the heart is an injury attended by a fatal result. Gamgee collected 28 cases, in 9 of which there was no lesion of the thoracic parietes. The pericardium was uninjured in about half of the cases. Traumatism caused rupture of the right ventricle in a majority of the cases. The non-traumatic cases of rupture chiefly affect the left ventricle. In all of these cases of rupture of the heart the muscular walls are usually the seat of fatty degeneration.

Rupture of the heart has occurred during tetanus or in consequence of complete obstruction of the branches of the coronary arteries by a thrombus or an embolus, by an abscess of the walls of the heart bursting into the cavity, or by the sudden escape of blood from a ruptured aneurysm.

Wounds of the heart may occur in consequence of traumatism of the thorax, such as gunshot- or stab-wound, or by perforation of a rib. These wounds are not necessarily fatal, since several have been reported in which recovery took place.

The **symptoms** of wound of the heart are sharp and constant pain, cardiac syncope, hemorrhage into the pericardium, accompanied by flatness upon percussion and an enlargement of its normal area, and diminution of the heart-sounds. Death is caused by shock and pulmonary anæmia, although life may be prolonged for some hours. Death may also be caused by the mechanical pressure of blood in the pericardium upon the heart, or by a failure of the heart to contract owing to the injury of the cardiac muscles.

The **treatment** of wounds of the heart consists in lowering the head to prevent cerebral anæmia, the administration of opium to relieve the pain and to control the inflammation, and the application of artificial

warmth to the surface of the body. Over-stimulation is attended with fatal results, since it provokes inflammation, causes hemorrhage, and increases the shock by producing additional pain.

The *thoracic duct* is the channel which conveys lymph and chyle into the blood. All the lymphatic vessels of the body empty into it with the exception of those which are situated upon the right side of the thorax, neck, and head, the corresponding arm and lung, and the convex surface of the liver. The thoracic duct is about eighteen inches in length, and begins opposite the second lumbar vertebra and extends to the root of the neck. At its beginning upon the second lumbar vertebra is found the receptaculum chyli, which is behind and to the right side of the aorta.

The receptaculum chyli is formed by three branches, the middle one of which collects chyle and lymph from the intestine, the inner and outer from the respective extremities. It perforates the diaphragm through the aortic opening, still lying upon the right side of that vessel, and in the thoracic cavity lying between the aorta and the vena azygos major. At the fourth dorsal vertebra the thoracic duct ascends behind the arch, and inclines to the left side of the œsophagus and posterior to the first part of the left subclavian artery. Upon a level with the upper border of the seventh cervical vertebra the thoracic duct forms a curve downward over the subclavian artery in front of the scalenus anticus muscle, and empties into the left internal jugular vein near its junction with the left subclavian jugular vein. It occasionally happens that the duct bifurcates, and one branch terminates as just described, while the other empties into the right subclavian vein with the right lymphatic duct. Upon the right side of the body the right lymphatic duct empties into the right subclavian and internal jugular veins at their junction. This duct is only about one inch in length, and it, as well as the common duct, is provided with valves to prevent the entrance of venous blood. The termination of either duct is subject to certain anatomical anomalies, but they are of no special interest to the surgeon except in cases of injury during a surgical operation. The duct has been displaced in cases of angular curvature, so that the vessel is nearer to the field of operation than is normal.

"The lymph-vessels gradually join to form larger vessels, and finally end in one trunk. Thus the sectional area diminishes, so that the velocity of the current and the pressure are increased. Nevertheless, the velocity is always small; it varies from 230 to 300 millimetres per minute in the large lymphatic in the neck of a horse—a fact which enables us to conclude that the movement must be very slow in small vessels. The lateral pressure at the same place was 10 to 20 mm., and in the dog 5 to 10 mm. of a weak solution of soda, although it was = 12 mm. Hg. in the thoracic duct of a horse" (Landois and Stirling).

"Observations on the pressure and flow of fluid in the larger lymph-vessels indicate a far more sluggish circulation than in the case of the blood; in the thoracic duct the pressure is between 1 and 2 cm. of water, and the current flows at a rate below $\frac{1}{2}$ cm. per second, and the total amount of fluid traversing the duct per diem is less than 5 litres" (Waller).

"Now, the lymph in the lymphatic spaces outside the capillaries and minute vessels undoubtedly stands at a lower pressure than the blood

inside the capillaries, otherwise the transudation from the blood into the tissues would be checked; but the difference is probably much less than the difference between the pressure in the capillaries and that in the large venous trunks. So that the lymph in the lymph-spaces of the tissues may be considered as standing at a higher pressure than the blood in the venous trunks; for instance, in the jugular vein. That is to say, the lymphatic vessels as a whole form a system of channels leading from a region of higher pressure—viz. the lymph-spaces of the tissues—to a region of lower pressure—viz. the interior of the jugular and subclavian veins. This difference of pressure will, as in the case of the blood-vessels, cause the lymph to flow onward in a continuous stream" (Foster).

The surgery of the thoracic duct is usually associated with injuries of other important structures in the abdominal and thoracic cavities, but occasionally the duct is wounded without this complication. The subjects for discussion are injuries, disease, and tumors of the thoracic duct.

Injuries of the thoracic duct have occurred during life and healed spontaneously. This has been often proved by the evidence afforded by post-mortem examinations. Such traumatisms are of no special significance and are mere surgical curiosities. Extreme injury of the duct is usually associated with that of other vessels, and is rapidly fatal. Patients with any extensive wound of the thoracic duct have usually died in four or five days from compression of the lung and heart. Of course death by inanition may follow in fifteen days or more if the wound is not so situated as to cause suffocation by compression within four or five days. The duct has been wounded during an operation for removal of a tumor from the root of the neck. In this case, which occurred in the practice of Wilms of Berlin, in 1880, during a deep dissection for the removal of a carcinoma from the neck, a whitish fluid escaped from the bottom of the wound. The absence of an empyema, the pus from which in its gross appearance might be mistaken for chyle, and the character of the fluid, which differs from the light-yellow fluid found in a lymphatic duct, serve to corroborate the diagnosis of wound of the common duct near its entrance into the left internal jugular vein. Without doubt small stab-wounds or pistol-shot wounds in the back or upon the side in which the thoracic duct was injured have occurred, but owing to the remarkable power of contractility which the duct possesses, together with the small amount of lymph-pressure as compared with arterial pressure, these injuries have spontaneously healed. The small amount of lymph-pressure is illustrated in a case where the duct was ligated in a dog, and after the receptaculum chyli was fully dilated, as well as the common duct, a wound of the duct was purposely made by an instrument, and but little extravasation occurred.

Experiments on executed criminals have shown that a few minutes after death irritation by electricity has caused remarkable contraction of the duct, so that during life it is fair to presume that these small wounds close quickly by contraction and heal without any extensive extravasation. A series of most interesting experiments on horses, dogs, rabbits, etc. confirms the statements that small wounds of the thoracic duct heal very quickly; that they are not likely to be attended by serious extrav-

asation of lymph; that the animals quickly die of sepsis from infection of the pleura unless rigid antisepsis is exercised; that the animals die in a few days from compression of the lung and heart in case serious extravasation occurs, and at a period before starvation would account for the death of the animal.

The same series of experiments demonstrated that death will follow in about fifteen days from inanition if the lymph and chyle do not enter the vein and right side of the heart. In animals experiments made by conducting the contents of the thoracic duct to the outside of the body by means of glass cannulæ demonstrated the fact that starvation was the cause of death. In the small wounds of the duct the healing process was consummated by contraction and retraction of the muscular fibres of the coats of the vessels, by a certain amount of compression exercised upon the vessel, and by a coagulation of the lymph and fibrin.

The **treatment** of injuries of the thoracic duct within the thoracic cavity consists in anticipating the certainty of death by suffocation. This is accomplished by tapping the thoracic cavity, and at once relieving the compression of the lung and heart by the withdrawal of the extravasated lymph-fluid. If this cause of death can be thus removed, the remote cause of death by inanition is sometimes relieved by a collateral anastomosis in the lymph-channels. Hence an injury of the thoracic duct is not necessarily fatal if the compression can be mechanically removed by the surgeon, and if the danger of starvation of the patient can be prevented by the intervention of nature in the establishment of a collateral anastomosis. The writer has seen one case of wound of the duct in a boy who while coasting injured his abdomen. The patient had a collection of chyle in his pelvis, and finally the intra-abdominal pressure was so great that an abscess formed. This was opened, and for several weeks chyle flowed from the cavity. Finally it spontaneously healed and the boy entirely recovered. Another case very similar to this is reported by Manly in the *Medical News*, Nov., 1894. In both of these cases, as well as in others, the pressure was so slight in the duct that the wound healed spontaneously, and in the same manner that a vein heals after injury.

Diseases of the thoracic duct include inflammation, abscess, gangrene, tuberculosis, and calculi.

Inflammation of the duct is caused by sepsis, and has occurred in connection with puerperal fever, suppurative nephritis, pneumonia, diphtheria, and other infective processes. The walls of the duct are thickened, the inner lining membrane softened and bathed with an inflammatory exudation. The lumen of the duct is filled with blood and pus. In addition to this change the glands in the track of the duct are enlarged and are infiltrated. These inflammations have hitherto been fatal, but it is possible to conceive, as the technique of abdominal surgery improves and finer methods of diagnosis are acquired, that surgery may yet accomplish something to relieve this condition, especially as it has been demonstrated that wounds of the duct will heal.

In like manner *abscess* and *gangrene* of the thoracic duct have been observed at autopsies, and what has been said in connection with inflammation of the duct will equally apply to these conditions. Retentive cysts have been observed in which a tumor was formed consisting of

lymph and chyle. Owing to the pressure-effects of the cyst, the rib was eroded, and the cyst presented at the side and was opened.

Tuberculosis of the duct has been observed in autopsies of persons who have succumbed to lung-tuberculosis. In these cases tubercles were found in the mesenteric glands and upon the peritoneum. There have been a few cases in which the autopsies demonstrated tuberculosis of the duct without lung-tuberculosis. These cases have been in young people.

A *calculus* has been observed in a case in which the patient died from exhaustion after many tappings for ascites. The stone only partially occluded the duct from the receptaculum chyli, since the stone was perforated in many places like a sieve and permitted the chyle to pass through the duct.

Tumors of the thoracic duct have been frequently observed. These neoplasms were not primary, but secondary to malignant diseases of the testicle or uterus. It is a clinical fact worthy of note that in one case of cancer of the duct the metastasis was from an undescended testicle which was the seat of primary carcinoma. Primary carcinoma of the lumbar glands has also caused a secondary deposit in the duct.

Compression of the duct has been caused by tumors in the abdominal and thoracic cavities, among which may be mentioned osteoma of the pelvis, aneurysm of the aorta, and pleuritic effusions.

Lesions which affect the mediastinum have recently been brought into surgical notice. Before, however, entering upon a consideration of the surgery of the mediastinum a brief description of the surgical anatomy is pertinent.

The mediastinum is the space in the median line of the chest formed by the non-approximation of the pleuræ. This space is bounded in front by the inner surface of the sternum, behind by the vertebræ, and laterally by the pleuræ. With the exception of the lungs, all the thoracic viscera are contained in this space, which is subdivided into an anterior, a middle, and a posterior mediastinum.

The anterior mediastinum is bounded in front by the inner surface of the sternum, behind by the pericardium, and laterally by the pleuræ. This space is directed obliquely downward and slightly to the left side. The space is wide below, since the pleuræ diverge from each other, and it is narrow above, where the serous sacs are in close proximity.

The anterior mediastinum contains the internal mammary vessels of the left side, the origins of the sterno-hyoid, sterno-thyroid, and triangularis sterni muscles, and the thymus gland and lymphatics which ascend from the liver, which are held in a bed of loose areolar tissue.

The middle mediastinum is the broadest section of the interpleural space, and contains the heart in the pericardium, the pulmonary arteries and veins, the ascending aorta, and the superior vena cava, the bifurcation of the trachea, and the phrenic nerves.

The posterior mediastinum is an irregularly-shaped cavity, and is bounded in front by the root of the lungs and the pericardial sac, behind by the vertebræ, beginning above at the lower portion of the fourth dorsal vertebra, and laterally by the two opposing surfaces of the pleuræ. The contents consist of the œsophagus, the thoracic duct, lymphatics, also the pneumogastric and splanchnic nerves, the left superior intercos-

tal vein, the greater and lesser azygos veins, and the descending portion of the arch of the aorta.

The lesions which affect the mediastinum are injuries, diseases, and tumors.

Among the *injuries* of the mediastinum may be mentioned contusions, wounds, fractures, and dislocations of the sternum. They are generally produced by gunshot- or stab-wounds or by a blow upon the sternum.

Wounds of the mediastinum sometimes affect the heart, and the injury is of course very serious; still, there are many authenticated cases of recovery after a wound of the heart. If the wound affects any of the large vessels, death follows, as a rule, in a few seconds or moments in consequence of hemorrhage. Heil reports a case where the aorta was wounded and the patient made a prompt recovery. At the expiration of a year the patient died from some disease, and the post-mortem examination revealed the presence of a cicatrix. In all wounds of the mediastinum there is danger of acute suppurative inflammation which develops a pleuritis or a pericarditis.

Hæmatoma is a complication that often ensues in consequence of a wound involving this space, as well as from traumatism upon the front of the chest. The symptoms of hæmatoma are very obscure, and are often similar to those indicating the presence of a well-developed neoplasm, with the exception that in the hæmatoma the onset is sudden, while in the tumor the onset is gradual.

The **treatment** of injuries of the mediastinum varies according to the nature of the lesion. If the trouble involves any inflammatory condition, the application of well-recognized principles of antiseptic surgery are required. If the large vessels are injured, the patient is likely to succumb rapidly to the effects of hemorrhage. If some of the smaller vessels are wounded, they should be ligated and the wound dressed with special antiseptic precautions. If the wound is a perforating one, it can be rendered aseptic and hermetically sealed by placing over the opening a small pledget of absorbent cotton upon which is painted a solution of styptic collodion and iodoform. In case a fracture exists, the application of the ordinary dressing for this injury is indicated. Opium is a drug that can be used to great advantage in these cases, because it diminishes the number of the respirations and at the same time has a controlling influence over inflammatory action.

Inflammation of the mediastinum, or mediastinitis, may be either acute or chronic. Acute mediastinitis develops in consequence of extension of infection from cervical abscesses, from caries and necrosis of sternum or ribs, or as the result of traumatism, such as a stab- or gunshot-wound of the chest or in conjunction with contusions and fractures of the sternum. This affection has been observed as a sequel or complication in typhoid fever, measles, and also erysipelas.

The **symptoms** of acute mediastinitis consist of a throbbing sensation beneath the sternum, with deep-seated pain increased upon coughing or swallowing, dyspnœa, cyanosis of face, and localized œdema over the front of the sternum. Palpation demonstrates the presence of fluctuation, and there is bulging at the side of the sternum or at the episternal notch.

If percussion is made over the abscess, there is found dulness, which changes slightly according to the position of the patient; also loss of respiratory sounds over the abscess.

The constitutional symptoms consist of rigors, elevation of temperature, irregular and rapid pulse, vertigo, and cephalalgia.

The **prognosis** of acute mediastinitis depends upon the constitution of the patient, the special variety of suppuration, and the tendency of the pus to burrow. If the surgeon can open and drain the abscess, the prospects of recovery are favorable. Great danger lies in the fact that the pus may find its way into the trachea or bronchial tubes or cause pressure-necrosis of the sternum.

The **treatment** of acute mediastinitis, if it does not undergo resolution, consists in carefully dissecting down to the pus-cavity at the point where the fluid bulges, providing an escape, and then introducing a drainage-tube. All of the pus should not be evacuated at once, since the sudden withdrawal of so much fluid might cause fatal syncope. With surgical treatment nearly 50 per cent. of the cases of mediastinitis recover.

If it is impossible to reach the pus by incision, trephining the sternum has been practised in a few cases. This operation is dangerous, and should not be employed without serious consideration. If pressure-necrosis has taken place, excision of the sternum, a still more dangerous procedure, is indicated in order to save the patient's life. The surgeon should be on his guard lest he mistake abscess for aneurysm, since in the latter case operative interference would be attended by instantaneous death.

For **diagnosis** of aneurysm in this situation the reader is referred to the article on Aneurysm.

Chronic mediastinitis may be the result of infection from tuberculous pulmonary nodules, or it may originate as a primary glandular affection, or be caused by scrofulous disease.

The **symptoms** of chronic abscess are very similar to those enumerated for acute abscess. If the abscess is located in the posterior mediastinum, the pain sometimes is transmitted to the shoulder or is felt with great severity on the front of the chest-wall at the termination of the intercostal nerves. If the pneumogastric nerve is irritated, the function of that nerve is affected, as is manifested in the disturbance of the pulse, digestion, and deglutition.

The **treatment** consists of aspirating the abscess as soon as the presence of pus is determined. Care should be taken lest any air is admitted into the chest, since an acute abscess engrafted upon a cold abscess would be rapidly fatal. If the pus points, an incision can be made under the most strict antiseptic precautions and the cavity drained. Only a part of the fluid should be withdrawn at one time.

Tumors situated in the mediastinum are frequently observed. They are divided into two separate groups, benign and malignant. In the first list may be mentioned lipoma, fibroma, dermoid and hydatid cysts, enlargement of the thymus and mediastinal glands. The second group consists of carcinoma, sarcoma, lymphoma.

Carcinoma of the Mediastinum.—This is the most frequent malignant disease affecting the mediastinum. In the majority of the cases the seat

of the disease is in the anterior mediastinum. The disease occurs during adult life, and may originate as a primary growth or it may occur as a secondary deposit in connection with carcinoma of the mammary gland. The starting-point may be in the bronchial or tracheal glands, in the remains of the thymus, from the periosteum lining the sternum, or in the abundant loose areolar and connective tissue in this space, or the growth may spring from the pulmonary structure. The most frequent variety is the medullary, since scirrhus or colloid forms only a small percentage of the cases.

The **symptoms** of carcinoma of the mediastinum consist of dyspnœa, lancinating pain, cough, aphonia, epistaxis, tinnitus aurium, dysphagia, palpitation with anginoid pains, cyanosis, and œdema of the neck from obstruction to the venous return, and dropsy of the serous sacs within the thorax and abdomen. The heart is pushed to one side, a symptom not usually found in aneurysm, and the disturbance in the circulation often causes œdema of the feet. If the pressure affects the pneumogastric or phrenic nerves, symptoms appear which indicate disturbance in the function of those nerves.

The **physical signs** of a growth in the mediastinum have many points of difference as contrasted with serous and purulent effusions and with a chronic non-resolving tuberculous pneumonia.

The differential **diagnosis** between aneurysm and mediastinal tumor is often very difficult, inasmuch as either of the two affections is capable of duplicating any of the physical signs produced by the other.

The reader is referred to special treatises on physical diagnosis to obtain comprehensive knowledge which would afford the necessary information for the purpose of establishing a differential diagnosis.

The **treatment** of carcinoma of the mediastinum consists of removal of the growth if the circumstances of the case permit.

Sarcoma of the mediastinum is the malignant disease which is found, according to Hare, next in point of frequency to carcinoma. The disease is usually primary, but occasionally occurs as a metastatic deposit from sarcoma of the pleuræ. It may sometimes be a metastatic growth from sarcoma of the abdominal organs, in which the disease is carried into the anterior mediastinum by vessels and lymphatics through the œsophageal opening in the diaphragm. In primary sarcoma of the humerus secondary deposits are occasionally observed in the mediastinum, while sarcoma affecting the lower extremity has its secondary deposits in the lumbar and pelvic and abdominal glands. The disease is unlike carcinoma in that it may simultaneously attack different organs and structures in the body, and this clinical fact affords the surgeon a most important link in the chain of evidence as to the differential diagnosis between this tumor and carcinoma.

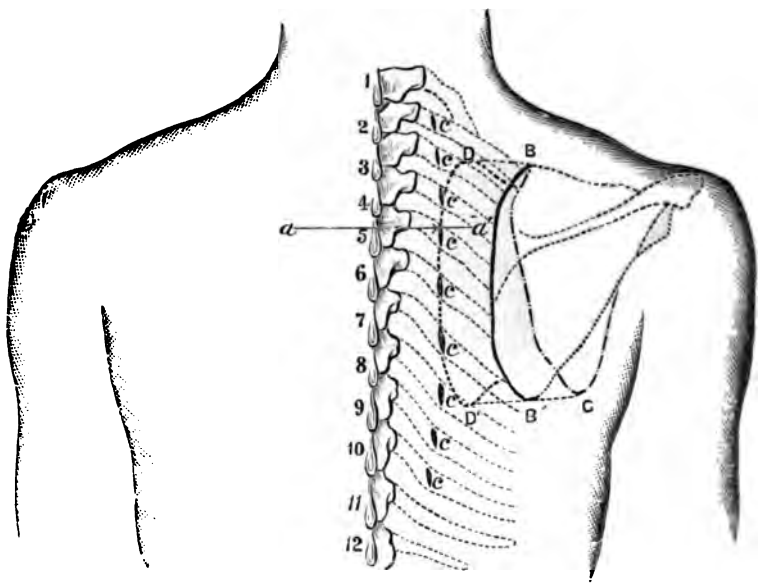
The **symptoms** denoting the presence of sarcoma are very similar to those already described in connection with carcinoma of the mediastinum. The chief characteristic is the great rapidity of the growth in sarcoma and its multiple appearance in the body.

The differential **diagnosis** between this and other intrathoracic affections has been considered under Carcinoma.

The operation for removal of posterior mediastinal tumors, for the evacuation of pus, for the relief of intrathoracic pressure from enlarged

glands, as well as for the removal of foreign bodies from the œsophagus and bronchi, has been recently described by Dr. J. D. Bryant in a paper read before the American Surgical Association in 1895. This surgeon has called attention to the important anatomical facts that the lower portion of the fourth dorsal vertebra is the boundary-line between the posterior mediastinum and the lower part of the superior mediastinum; that the end of the spinous process of any dorsal vertebra, with the exception of the first, eleventh, and twelfth, marks the situation of the posterior extremity of the rib; that the first, eleventh, and twelfth dorsal vertebræ are just above the transverse processes of the

FIG. 53.



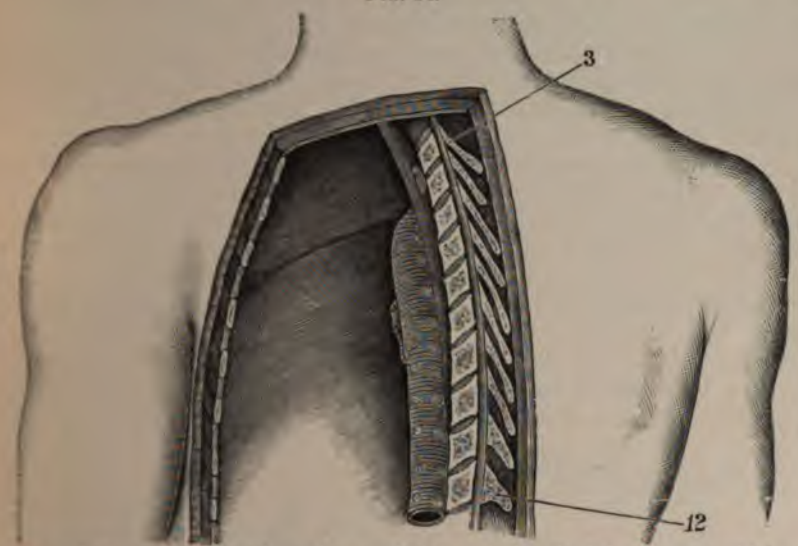
Showing (1) the relation of the tips of the spinous processes to the rib below; (2) the centre of the operation-field for right bronchus (*a-a*); (3) angles of ribs (*c, c, c*); (4) posterior border of scapula, with shoulder pushed backward (*D, D*); (5) posterior border of same with shoulder falling forward (*B, B*); (6) posterior border of same with arm hanging over side of operating-table (*B, C*), (Bryant).

vertebræ immediately below; that the border of the scapula changes according to the position of the arm and shoulder (Fig. 53); that the œsophagus is best reached posteriorly upon the left side of the median line if above the arch of the aorta, but upon the right side of the spine if below the arch (Fig. 54); that the posterior opening to reach the bronchi is to be determined by the location of the foreign body; that the distance of the bodies of the first, second, third, fourth, fifth, and tenth dorsal vertebræ from the superior incisor teeth is respectively 8, $8\frac{5}{8}$, $9\frac{3}{8}$, $10\frac{1}{8}$, 11, and 15 inches; and, finally, that the thickness of the bodies of the dorsal vertebræ, including the intervertebral substances, is respectively $\frac{5}{8}$, $\frac{6}{8}$, $\frac{6}{8}$, $\frac{6}{8}$, $\frac{7}{8}$, $\frac{7}{8}$, $\frac{7}{8}$, $\frac{7}{8}$, 1 inch, $1\frac{1}{16}$, $1\frac{1}{8}$, $1\frac{1}{4}$ inches in a person whose stature was five feet eight inches.

The technique of this operation for the various indications as described by Dr. Bryant will be given, by his permission, in his own words:

"*The Position of the Patient.*—The patient should be placed obliquely on the abdomen, with the shoulders so supported as to cause the least possible interference with the respiratory movements of the thorax. The side of the body to be attacked should be uppermost and exposed to the best light possible. The body should be securely fixed in this posi-

FIG. 54.



Showing relations of vessels and œsophagus, which is pushed to the left, and upon which may be seen a lymphatic gland; also the left bronchus passing to the lung in front of aorta, opposite to the seventh dorsal vertebra (Bryant).

tion, in order that no disturbance of it shall interfere with the line of vision nor lead to a misdirection of the manipulative methods employed for the purpose of relief. Each assistant should be at his post and have received careful instructions on the line of his duty.

"*The Ascertainment of the Proper Seat of the Operation.*—This step is a very important part of the procedure, and should be accomplished with great care and deliberation, since the proper location is essential to a good view of the deep parts of the wound and to the precise and delicate steps of the most important part of the operation. The centre of the field of operation should correspond to the seat of obstruction for obvious reasons. If the obstruction be in the œsophagus and of a metallic nature, or any substance of sufficient density to produce sound when percussed by a metallic bougie, a stethoscope applied to the back, especially to the right side, may define the situation by fixing the point of greatest intensity of sound.

"The comparative location of the obstruction may be estimated also by ascertaining its distance from the upper incisor teeth by means of a graduated bougie, after which the relation of the obstruction to any individual vertebra can be determined either directly by means of the measurements already given as indicating the distance to the teeth, or indirectly by computation based on the thickness of the respective vertebræ and intervertebral substances, as before determined. In the case

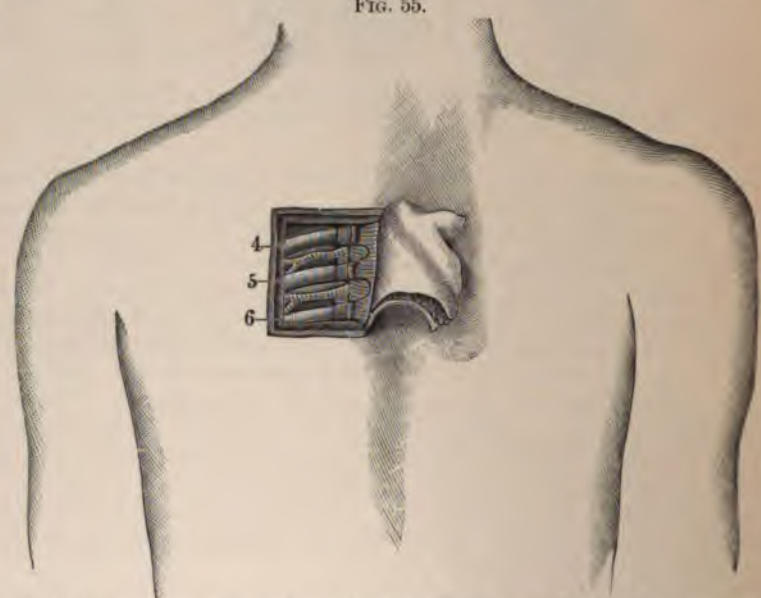
of subjects of similar development to those on which the measurements are based it will be quite easy to ascertain the contiguity of an obstruction of the œsophagus to a particular dorsal vertebra, and from this fact determine the numerical position of the rib that should be regarded as the centre of the operation-field. However, a deviation from these examples, dependent on the length of the body or due to disease or deformity of the dorsal vertebra, will, of necessity, impair the value of the scheme as applied in this particular instance.

"It is needless to add that an exact method of measurement applicable to devious cases cannot be devised. Still, it is true that careful consideration addressed to the method already stated will locate with practical accuracy the point of attack.

"Having determined numerically the body of the vertebra contiguous to the obstruction, the tip of the spinous process of this vertebra and the one above should be carefully located. It will be noticed that, as a rule, the tip of the spinous process of a vertebra is opposite to the rib of the next vertebra below, and therefore the tip of a spinous process will indicate quite correctly the rib at the centre of the field of the proposed operation.

"*The Shape and Size of the Flap.*—A flap three inches square, including the tissues down to the ribs and reflected inward, affords ample space for work and observation (Fig. 55). The vertical diameter should

FIG. 55.



Showing the three ribs and the associated vessels. The flap, composed of all the tissues down to the ribs, is reflected across the spine (Bryant).

correspond to three ribs, the middle one of which should be the centre of the operation-field. The transverse or parallel incisions should be made carefully, otherwise the knife may pass between the ribs and enter the pleural cavity.

"*The Treatment of the Ribs.*—Portions of not less than three ribs must be displaced from the angles to the outer extremities of the transverse processes, in order to gain proper room for observation (Figs. 55 and 56). The middle one of the three should be carefully divested of the soft parts on the external surface and the borders by means of a sharp periosteotome, being careful that the instrument does not enter the thorax inadvertently or tear the parietal pleura. The pleura is then separated from the anterior surface of the rib by means of a strong antiseptic silk ligature, carried beneath it by an aneurysm needle, and operated to and fro beneath the rib by a sawing motion until this surface of the bone is free the entire width of the wound. The ligature is then used to draw a chain-saw into position, with which the rib is divided at each limit of exposure, or the rib may be cut across at these places with bone-forceps. The former is much the safer plan, since in the latter the ends of the instrument may tear the pleura or the resulting tiny fragments perforate it. The fragment of rib thus separated is cast aside entirely.

"The next step is the *very cautious* separation of the pleura from the inner surfaces of the ribs above and below the opening. The fingers

FIG. 56.

Showing the flap turned across the spine to the left side; the divided extremities of three ribs (fourth, fifth, and sixth); the fragment of the middle (fifth) is removed, and the other two (fourth and sixth) are severed and turned outward, the intercostal tissues between them and the contiguous ribs being intact, and the vascular supply unimpaired (Bryant).

only should be used for this purpose, and the manipulations made during expiration alone. Having separated the pleura around about the opening, attention is next directed to increasing the size of the thoracic wound by the displacement of a similar portion of the adjacent ribs.

"Prior to attacking these ribs the intercostal vessels between them and the place occupied by the rib already removed (Fig. 56) should be tied at the outer and inner limits of the wound. They are then divided the same as the first, but with as little disturbance as possible of the soft parts, in order to maintain the nutritive integrity of the fragments.

After the division they are turned outward from the wound, being hinged as it were to the contiguous ribs by the intervening intercostal structures, in the midst of which the intercostal vessels pass undisturbed (Fig. 56).

"This method of treatment of the bony fragments secures for them the best possible nutritive advantages in case they be returned and fastened in position, and also it reduces to a minimum the danger of laceration of the pleura by the bony extremities, as is liable to happen if they be turned inward toward that structure. The separation of the pleura from the ribs, bodies of the vertebræ, etc. must be conducted with great care, otherwise the membrane will be torn. If a rent take place, it should be closed at once by antiseptic silk or catgut."

The Prevention and Control of Hemorrhage.—Prompt ligature of bleeding points during the making of the flap, forestalling ligatures at the time of the displacement of fragments of ribs, and careful manipulations in the approach to the obstruction offer the measures best intended to prevent the occurrence of hemorrhage. If hemorrhage happen, I am not aware of any special means of arresting it applicable to this region alone.

The Location of the Obstruction is made out easily, if it be in the œsophagus, by the combined aid of the finger in the wound and a bulbous bougie in that passage. If the pleura be pushed gently outward with the fingers, the movements of the bougie in the œsophagus can be easily seen through the greater part of the cavity at the right side. A strong electric light is a very important aid at this time, as it clearly delineates the structures between the obstruction and the approach of the surgeon. If the obstruction be in a bronchus, this tube can be easily felt by the finger at the proper location for some time before it is exposed to view. The incomplete rings are so characteristic of the bronchus that nothing else can be mistaken for it. The bronchi are located directly forward about an inch and a half from the opening into the chest.

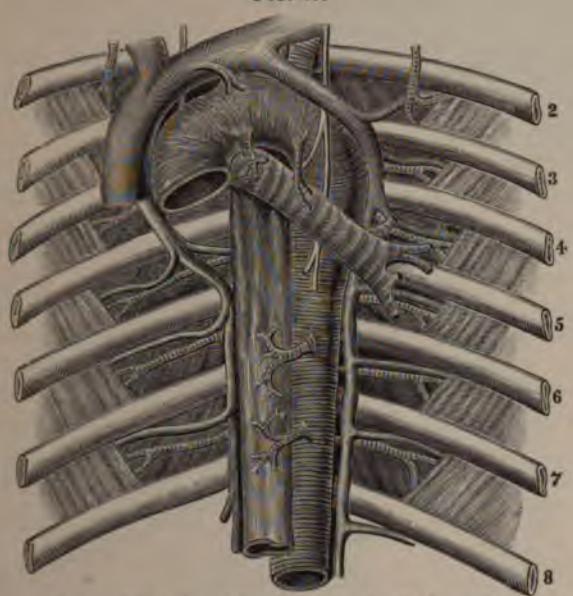
The Avoidance of Important Structures relates not only to the approach of the situation of the obstruction, but also to the entry of the passages containing it. As already announced, I shall not burden the reader with a description of anatomical relations that are already a matter of approved record. Suffice it to say that the venæ azygos, the aorta, and the pulmonary vessels, along with the pneumogastric nerves, must be carefully approached and considerately treated (Fig. 57).

The Removal of the Obstruction.—If the obstruction be of the œsophagus or bronchus, the incision for removal should be made in the long axis of the tube, and of sufficient length to permit the removal of a foreign body without laceration of the tube-structure. Long-handled instruments with short blades and biting surfaces are essential, not only on account of the depth of the wound, but for the purpose of economizing space and permitting the entrance of light.

The treatment of the wounded tube is simple, in my opinion. The tube should not be closed, for, if this be done, it will surely open again, because of the presence of mucus and inflammatory products that rapidly supervene as the result of the obstruction, to say nothing of similar products caused by the manipulative procedure itself, or of the mucous secretions that are normally present for physiological purposes alone.

While the exact technique of treatment is yet to be determined, still the writer is of the belief that an iodoform tamponade, supplemented with

FIG. 57.



This figure is a somewhat modified view, taken from Morris. It shows the relation of the œsophagus to the aorta below the arch, the intercostal vessels, and the venæ azygos, and the relation of each to the ribs, intercostal tissues, œsophagus, etc. (Bryant).

centrally located drainage-tubes, will meet rationally the many indications of such a case.

The Establishment of Drainage and Replacement of Rib-fragments are obviously of great importance. An ordinary aseptic dorsal dressing, plus the tamponade already mentioned, should provide satisfactorily for the discharges. The central rib-fragment is not replaced, but the upper and lower ones are replaced and fastened in position by means of silkworm gut or fine wire. It is believed that if a proper aseptic state of the parts can be maintained, the fragments will be nourished sufficiently by their vascular hinge-like attachments to the ribs immediately adjoining to secure prompt and serviceable union.

The adjustment of the flap and dressing of the external wound, particularly the former, is a step that must be considered carefully. Of course the flap cannot be accurately adjusted at the outset, on account of the presence of the dressings already described. However, I have no special dressings to commend for this occasion. Those of ordinary use for aseptic results will suffice.

The operation bespeaks urgent requirement, and grave consideration coupled with consummate care and forethought, ere the attempt be made to practise it. It should not be attempted until other means of relief are tried and have failed. Nor should delay in the attempt have sacrificed already the strength and courage of the patient. Aseptic methods, great caution, and the ability to scrutinize the steps of the procedure are

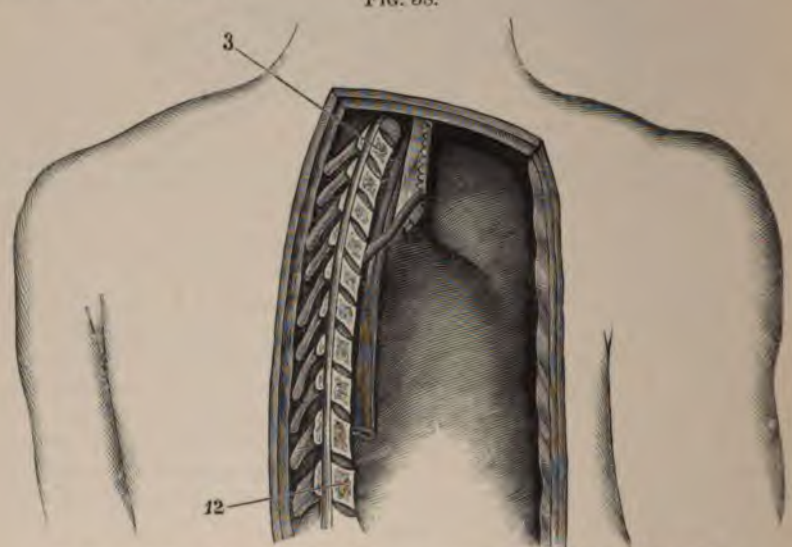
the technical guides to safety and success. The advantages of the posterior over the anterior incision for the purpose of gaining access to the bronchi or œsophagus are almost too obvious to require mention. The complex anatomical relations of the anterior way are substituted by the much simpler ones of the posterior. The great desideratum of all wounds, and especially those of septic associations, is good dependent drainage. And, if for no other reason than this, the posterior way possesses an advantage which the anterior cannot offset even by the weight of everything to be said in its favor.

The seat of pressure on the œsophagus from without can be located in the same manner as when the lumen is obstructed from within. While non-malignant involvement of the posterior mediastinum may be amenable to surgical treatment, yet none can expect to add comfort or longevity to one affected with malignant disease in that situation by the employment of surgical means.

In conclusion the writer submits the following propositions:

"1. That, when other means have failed, attempted relief from œsophageal or bronchial obstruction is justifiable by way of the posterior mediastinum (Fig. 58).

FIG. 58.



Showing relation of vessels and œsophagus upon the right side of body (Bryant).

"2. That below the arch of the aorta the œsophagus is reached better from the right side; above the arch it can be reached from either, though better from the left side (Fig. 59).

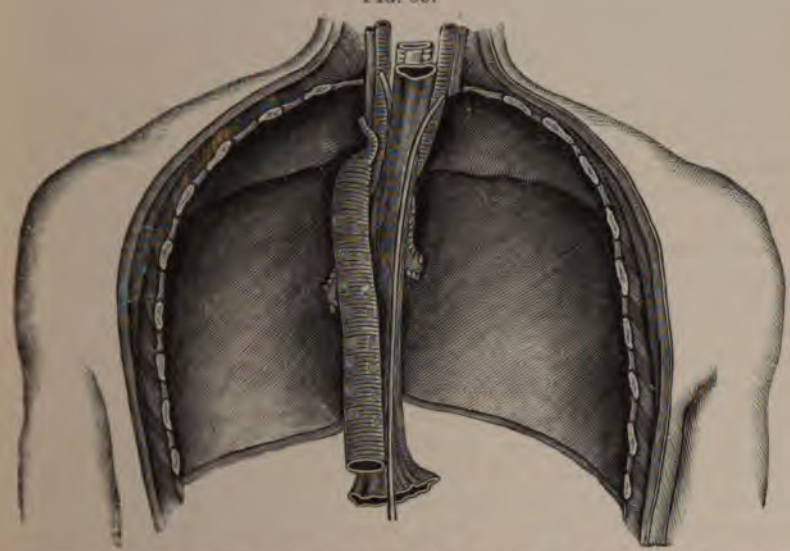
"3. That the attempted removal of obstructions situated below the body of the ninth vertebra is not justifiable, owing to the greater difficulty and danger of exposing the œsophagus at that situation.

"4. That the posterior entry to the mediastinum is more easily, quickly, and safely accomplished than that to the anterior, and offers better results than does the latter method of entry."

Lesions which affect the diaphragm have recently engaged the atten-

tion of surgeons. Before discussing any of these lesions a few observations upon the anatomy of the diaphragm may facilitate the understanding of the principles upon which operative interference is based. The diaphragm is a muscle which intervenes between the thoracic and abdominal cavities. In addition to its physiological function, it acts as a partition-wall between these two important cavities. It is attached posteriorly to the spine and laterally and anteriorly to the thoracic wall.

FIG. 59.



Posterior view of the aorta, œsophagus, and bronchi, showing the relation between the aorta and œsophagus upon the right side of the spinal column (Bryant).

During forced expiration the muscle rises to a level with the third cartilage upon the right side, and during forced inspiration descends to the level of the fifth intercostal space upon the same side. The muscle descends a little lower under the same conditions upon the left side. In cases of extreme distention from abdominal tympanitis the muscle has extended as high as the second rib, and in pleural effusions the diaphragm has even descended below the false ribs. The muscle has a serous lining both above and below, and consists of a reflection of the pleura upon its superior surface and the peritoneum upon the inferior surface.

Wounds of the diaphragm produced by gunshot injuries or the result of stabs are discussed in the special articles devoted to a consideration of these affections.

Rupture of the diaphragm is caused by traumatism, and may occur with or without a corresponding injury of the skin. Muscular action has also resulted in a tearing of the diaphragm. Rupture of the muscle has occurred as a result of the bursting of a liver-abscess, and the pus has found its way through the walls of the muscle and into the lung itself.

In cases of subphrenic abscess following perforation of a gastric

ulcer the pus has burst through the diaphragm into the pleural cavity. In these cases the pus is expectorated through the bronchial tubes, or may be evacuated by a thoracentesis when the pus is confined to the pleural cavity. The adhesion of the visceral and parietal pleuræ may prevent an empyema. If the adhesion is not present, then an empyema at once develops in consequence of the rupture.

A tumor may also force its way through and between the muscular fibres of the diaphragm and form a larger one in the thorax.

Rupture of the diaphragm, whether from traumatism or in consequence of disease or as a result of tumor, usually occurs in the fleshy part of the muscle and upon the left side, since the liver upon the right side affords some protection.

The symptoms of rupture of the diaphragm differ slightly according to the nature of the cause which produced the rupture. In cases of traumatism there is a rapid, irregular pulse due to disturbance of the pneumogastric nerve, a peculiar kind of respiration in which the thoracic accessory muscles are called into forcible action, loss of visible movements of the diaphragm during the respiratory act, a sinking in of the epigastric and hypochondriac regions of the abdomen, great dyspnœa, severe vomiting, intense pain, increased during a paroxysm of coughing, and hiccough. In cases where the rupture has occurred in consequence of the bursting of a liver-abscess or from a perforating subphrenic abscess the symptoms are essentially the same, with the additional changes consequent upon suppuration, and in the former case upon jaundice. The subsequent signs depend upon whether adhesion has taken place between the pleural surfaces. If the rupture is due to the pressure of a tumor, the symptoms appear slowly, and there is considerable disturbance before the tumor actually bursts into the thoracic cavity.

In the traumatic cases percussion gives rise to a peculiar tympanic resonance if the stomach or the intestine finds its way through the ruptured diaphragm. The normal respiratory murmur is also altered, owing to the presence of these viscera. If auscultation is employed, the surgeon can detect a succussion-sound in the stomach immediately after the patient has imbibed some fluid. The noise is very similar to the metallic tinkle, which is pathognomonic of fluid and air in the pleural cavity. The splashing of the fluid in the empty stomach is very distinct if the patient is shaken. In all of these cases of rupture of the diaphragm there is a peculiar facial expression indicative of great anxiety and suffering. Very soon after the rupture the physical signs of a beginning of pleurisy are present, and in a very limited number of cases the symptoms of a diaphragmatic peritonitis are also manifest. In 90 per cent. of the cases of rupture a visceral hernia is present without a sac. If a diagnosis can be established, a laparotomy should be performed and the displaced viscera returned to their normal cavity, and the rent or fissure in the diaphragm closed by silk sutures. Postemki has reported a case in which he successfully performed laparotomy, and after returning a traumatic omental hernia sutured the tear in the diaphragm. The writer has been able to collect eight cases in which the diaphragm was wounded and a laparotomy performed, with recovery in each case.

Paralysis of the diaphragm occurs in connection with injury or dis-

ease of the cervical portion of the spinal cord, and also in cases of fracture and dislocation of the vertebræ. This condition may also result in consequence of peripheral disturbance of the phrenic nerve, or even as a result of injury or disease of the diaphragm itself from diaphragmatic pleuritis and peritonitis, from pressure from mediastinal tumors and abscesses, and from toxic influences. Hysteria may also cause paralysis of the phrenic nerve, and thus give rise to paresis of the muscle. Diphtheria and lead-poisoning have been known to cause a paralysis of the diaphragm.

The **symptoms** of diaphragmatic paralysis are—loss of visible movement of the diaphragm during the respiratory acts, a sinking in of the epigastric and hypochondriac regions of the abdomen, an increase in the number of the respirations, with dyspnœa, especially when the patient makes any unusual exertion. If other muscles than the diaphragm are involved, the cause is in all probability central, while paralysis affecting this muscle only points to some injury or disease of the trunk of the phrenic.

The **treatment** of paralysis of the diaphragm depends upon the cause. If the condition is due to a fracture or a dislocation of the vertebræ, causing pressure upon a portion of the cord, the proper means should be at once employed to relieve pressure and to bring the bones in apposition, and to hold them immovably fixed by some apparatus like Sayre's plaster-of-Paris jacket, or even by a laminectomy if depression of the bones is apparent. If the paralysis is due to any of the causes mentioned in connection with peripheral irritation, means should be adopted to relieve the special condition. If the paralysis of the diaphragm is due to certain changes in the phrenic nerve which electricity can benefit, the application of the current can be made at a motor-point in the neck in a manner similar to that employed in resuscitating a patient in chloroform-narcosis.

If the paralysis is due to rupture of the diaphragm and the diagnosis can be established, a laparotomy is indicated for the purpose of closing the rent in the muscle.

Hernia of the diaphragm may present itself under one of *three* varieties:

First. The diaphragm may have some congenital defect which appears in the form of a fissure, and which permits the escape of some of the abdominal viscera into the thoracic cavity. This is rare, and is fatal sooner or later on account of strangulation of the contents of the abdomen.

Second. The diaphragm from some injury by a broken rib or from a rupture of the muscle nearer the posterior than the anterior part may present an opening through which the intestine may ascend, and eventually the parts become strangulated. In the traumatic variety the stomach and transverse colon, with a portion of the omentum, are the parts generally protruded. In 90 per cent. of the cases there is no peritoneal sac belonging to the parts, but the pleura, which is likewise a serous membrane, forms a sac for the abdominal viscera.

Third. A diaphragmatic hernia may occur at one of the natural openings of the diaphragm. The left side is commonly the place of exit for a hernia, inasmuch as the convex surface of the liver presses

uniformly against the arched surface of the diaphragm, and thus prevents any protrusion. The opening is generally situated upon the left side, between the xiphoid cartilage and the costal interspaces.

The **symptoms** of strangulated diaphragmatic hernia differ in no respect from hernia of other varieties. The usual symptoms of strangulated hernia are present, together with the additional symptoms of presence of a tumor in the thoracic region, which tumor seriously disturbs the action of respiration. There is, however, nothing pathognomonic to show with certainty the presence of a diaphragmatic hernia.

The **treatment** of diaphragmatic hernia varies according to the nature of the cause, since in the traumatic variety a laparotomy is indicated, while in the congenital form no operation will be of avail.

DISEASES OF THE EYE.

By G. E. de SCHWEINITZ, A. M., M. D.

Diseases of the Lids.

Abscess.—Abscess of the lid may be caused by injury, exposure, and disease of the orbit, or may arise without ascertainable cause.

Malignant pustule or specific anthrax and malignant œdema—that is, a form of spreading gangrene—are rare affections of the eyelids, the latter sometimes being the result of a neglected cellulitis; abscess also occurs as an idiopathic affection.

Treatment.—An ordinary abscess, after pointing has been favored by hot carbolized fomentations, should be opened by an incision parallel to the muscular fibres.

Hordeolum or Stye.—A stye is a furuncle, and consists of a suppurating inflammation of the connective tissue or of one of the glands in the margin of the lid. Styes tend to recur, and frequent attacks indicate deranged health. They are often associated with constipation and with menstrual irregularities. Styes are also caused by refractive error, especially hypermetropia, and by occupations exposing the patient to dust and wind.

Treatment.—Vigorous application of a hot boric-acid solution, rubbing the swelling with an ointment of the red or yellow oxide of mercury, or incision of the swelling through its base parallel to the edge of the lid.

Exanthematous eruptions may occur on the eyelid during the course of various eruptive fevers, in the case of small-pox sometimes resulting in the so-called *post-variolous ulcer*.

Eczema of the surface of the lids is common in any of its varieties —exanthematous, vesicular, and pustular—sometimes with facial eczema and sometimes as a separate implantation of the disease. The constitutional causes of eczema explain most of the cases; others occur in association with inflammations of the cornea and conjunctiva, especially those of a toxic nature, and from prolonged bandaging of the eyes.

The usual **treatment** for eczema is indicated.

Herpes Zoster Ophthalmicus.—The vesicles appear over the area supplied by two of the three branches of the ophthalmic—namely, the frontal through its supraorbital and supratrochlear branches, and, more rarely, the nasal nerve. If the latter nerve is involved, serious inflammation of the eye itself is almost sure to follow—irido-cyclitis, keratitis, and ophthalmitis.

Treatment.—The constitutional treatment of herpes is indicated—namely, iron, quinine, and, in the later stages, arsenic. Locally anodyne

solutions are useful, especially lead-water and laudanum and weak carbolic-acid solutions. If conjunctivitis, keratitis, or irido-cyclitis arise, the usual treatment for these conditions is required.

The **prognosis** is always serious, especially if the nasal branch is affected, and, even if the eye itself is saved, scars may remain on the cornea.

BLEPHARITIS.—Subacute and chronic inflammations of the ciliary margins appear in a *non-ulcerated* and in an *ulcerated* form. The former occur as simple hyperæmia of the lid-margins, characterized by redness and passive congestion of the superficial vessels, or in an abnormal secretion of the sebaceous glands, characterized by the formation of crusts and scales of hardened sebum at the roots of the cilia (*seborrhœa of the lid-margin*, or *squamous blepharitis*).

The ulcerated varieties manifest themselves as a *marginal blepharitis*, which resembles an aggravated hyperæmia; as a *blepharo-adenitis*, characterized by the matting of a tuft of cilia in a crust which hides a distinct ulcer; and as a *pustular inflammation*, with thick yellowish crusts which cover deep ulcers that tend to destroy the nutrition of the eyelashes. The lid-margins may become misshapen and everted, constituting the condition known as "*lippitudo*" or blear-eye.

Blepharitis is caused by refractive error, usually hypermetropic astigmatism, the exanthemata, disease of the rhinopharynx, and by eczema, acne, or seborrhœa of the face. It is common in strumous children, but may occur in healthy subjects. Abnormal shortness of the palpebral fissure is a predisposing cause.

Treatment.—Anomalies of refraction should be corrected with suitable glasses, and constitutional measures directed according to the condition which is present. The crusts should be removed with an alkaline solution (bicarbonate of sodium, eight grains to the ounce; biborate of sodium, four grains to the ounce) or by frequent washings with tepid water and castile soap. In the eczematous varieties the yellow oxide of mercury (gr. viij–℥j) is a suitable salve, while in the seborrhœas a 3 per cent. ointment of the milk of sulphur, or of resorcin, may be applied to the lid-margins. Other ointments are composed of boric acid, ten grains to the ounce, benzoated zinc, and aristol. In the severely ulcerated varieties the inflamed pits should be touched with nitrate of silver, or the ciliary borders may be painted with corrosive sublimate dissolved in glycerin (1 to 100–30). Obstruction of the lachrymal passages and disease of the rhinopharynx should be corrected, and if the cilia are misplaced, they should be removed with epilating forceps.

PHTHEIRIASIS OF THE LIDS.—When the pediculus pubis infests the eyebrows and eyelashes, it causes much irritation, and the affection may be mistaken for an ordinary blepharitis. The parasites should be destroyed by rubbing the edge of the lid with mercurial ointment or with a solution of corrosive sublimate.

SYPHILIS OF THE EYELIDS.—Small papular syphilides are sometimes seen upon the eyelids of infants the subjects of hereditary syphilis, and *madarosis*, or falling of the lashes, may be caused by the same disease. Hard chancres may develop on any portion of the area included by the lid-borders and inner canthus, the tarsal conjunctiva and cul-de-sac, usually from inoculation with the secretion from a syphilitic mouth.

TARSITIS.—This is a chronic, rarely acute, inflammation of the tarsus, causing an infiltration of the entire lid (Fig. 60).

FIG. 60.

Syphilitic tarsitis, from a patient in the Children's Hospital under the care of Dr. Randall.

If it is syphilitic, the usual constitutional remedies are indicated; if idiopathic, the treatment for chronic blepharitis.

BLEPHAROSPASM.—*Clonic blepharospasm* commonly occurs in the form of a twitching of a few fibres of the orbicularis muscle, and is significant of eye-strain or of some loss of tone in the nervous system, and will often promptly disappear with the use of suitable glasses. When it is more general and associated with twitching of the surrounding facial muscles, it has received the name of *habit-spasm*. It is frequent in nervous school-children, and almost always is associated with refractive error or follicular conjunctivitis and blepharitis. Iron, arsenic, and suitable glasses will cure the affection.

Tonic blepharospasm is a more or less persistent cramp of the orbicularis muscle, and is seen with keratitis and conjunctivitis.

More rarely, a cramp of the lids, occurring without obvious cause, continues for weeks and even months, and may be associated with temporary or permanent blindness. Some of these tonic cramps depend upon irritation of the peripheral trigeminal filaments.

Treatment.—The treatment demands the removal of any peripherally exciting cause—fissure, foreign bodies, keratitis, etc. Hypodermics of morphia will sometimes control the spasm, and conium and gelsemium have been used for the same purpose with good effect. In bad cases section of the supraorbital nerve has been performed. Persistent lid-cramp without obvious cause is a most intractable affection.

Diseases of the Conjunctiva.

Hyperæmia of the Conjunctiva, sometimes called *dry catarrh*, consists of an injection of the posterior conjunctival vessels, usually unassociated with the formation of abnormal secretion, and occurs in an *acute* and *chronic* form.

It is caused by the strain of uncorrected ametropia, by the early stages of cataract formation, and by local irritants; for example, dust and tobacco-smoke. It is common in those who abuse alcohol, and is seen with nasal catarrh, lachrymal obstruction, and, finally, in certain constitutional conditions, particularly those which are associated with other vasomotor disturbances. The so-called "hot eye" of gout is a form of conjunctival hyperæmia.

Treatment.—The various causes enumerated give the indications for treatment, proper glasses being especially needed. Locally, hot water and a solution of boric acid, biborate of soda, or alum may be employed. Nitrate of silver is not advisable.

To the various types of inflammation of the conjunctiva the generic term "conjunctivitis" is applied, for which the name "ophthalmia," employed by the older writers, is often used as a synonym. Conjunctivitis, for the sake of convenience, may be divided into six varieties:

1. Simple or Catarrhal Conjunctivitis (Muco-purulent Conjunctivitis).—This type is characterized by congestion of the posterior conjunctival vessels, loss of the transparency of the conjunctiva, some dread of light, œdema of the lid-margins, and the secretion of mucus or muco-pus, which is moderate in quantity, or copious and yellowish in color, approximating a purulent discharge.

Cause.—The disease is common in warm and changeable weather, and some of its types are markedly contagious. Usually both eyes are affected. There are many varieties; for example, those which occur as the accompaniment of the exanthemata (*exanthematous conjunctivitis*); as the result of micro-organisms (bacillus of Weeks) and which exhibit an epidemic tendency (*epidemic conjunctival catarrh*), one form often receiving the ridiculous name "pink-eye;" in connection with rheumatism, rhinopharyngeal disease, bronchitis, eczema, impetigo contagiosa, etc. (*associated conjunctivitis*); on account of local irritants, foreign bodies, wind, dust, etc. (*traumatic conjunctivitis*); and, finally, from neglected ametropia (*symptomatic conjunctivitis*).

The **prognosis** is good, and the affection will usually subside in one or two weeks. Corneal complications are uncommon. If neglected, however, and when occurring in homes, barracks, asylums, etc., conjunctivitis may become an exceedingly stubborn disease, most difficult to exterminate and encourage the formation of true trachoma. (See page 247.)

Treatment.—After removing the cause as far as this is possible, the following local treatment will be found efficacious: Frequent washing of the eyes with tepid water and castile soap; careful cleansing of the conjunctival cul-de-sac with boric acid (gr. xx–f ℥j), to each ounce of which may be added four grains of common salt, the solution being applied by means of an ordinary pipette or with the aid of an atomizer, and, during the stage of free secretion, the daily application to the completely everted lids of a solution of nitrate of silver (gr. v–f ℥j). As soon as the acute symp-

toms subside biborate of sodium (gr. iv–viij–f℥j), with or without the addition of camphor-water, may be used as the collyrium. Other solutions recommended are alum (gr. iv–f℥j), sulphate of zinc (gr. j–ij–f℥j), peroxide of hydrogen, which should be deprived of free acid, and corrosive sublimate (1 : 8000). The rhinopharynx should receive careful treatment. Constitutional measures are indicated by the patient's general condition, particularly a saline laxative followed by tonic doses of quinine. The eyes may be protected with goggles or a shade, but should never be bandaged nor have applied to them poultices, alum curd, scraped potatoes, tea-leaves, and similar pernicious domestic remedies. In the event of an epidemic of conjunctivitis in an asylum or similar institution, scrupulous attention to the isolation of affected inmates and strict cleanliness and the use of separate utensils and towels are necessary.

2. PURULENT CONJUNCTIVITIS.—This is usually considered under three heads: (*a*) *Purulent conjunctivitis* of non-specific origin, which is practically an aggravated type of the disease just described; (*b*) *Gonorrhœal conjunctivitis;* and (*c*) *Ophthalmia neonatorum.*

(*b*) *Gonorrhœal Conjunctivitis.*—This type of purulent conjunctivitis is caused by the inoculation of the conjunctiva with the secretion of an acute gonorrhœa or a gleet, and depends upon the micro-organisms which are active in these affections, the diplococci being found within the cells and later in the lymph-spaces and subconjunctival tissue.

The disease appears about forty-eight hours after inoculation, one eye alone, usually the right, being affected, although both may be involved.

The inflammation is of a most active character, and in rapid succession there appear chemosis of the conjunctiva, enormous swelling and reddening of the lids, and an abundant secretion of thick, greenish-yellow pus, which streams between the palpebral fissures and bathes the thickened, congested, and often bleeding conjunctiva (Fig. 61). The pressure of the swollen conjunctiva around the cornea perverts its nutrition, and haziness and ulceration speedily ensue. If ulcers form, perforation of the cornea is not infrequent, followed by prolapse and incarceration of the iris, staphyloma, and, it may be, panophthalmitis and shrinking of the eyeball. Even if the ulcers heal, large scars (or leucomata), to which the iris is adherent, mark their former position. In about six weeks the disease subsides, leaving the conjunctiva in a thickened and granular condition, often requiring weeks before a normal appearance is secured.

FIG. 61.

Gonorrhœal conjunctivitis (Dalrymple).

The **prognosis** is always serious, and unless the case is seen early and active measures are employed more or less destruction of vision is almost sure to follow.

Treatment.—The exact method of applying the remedies best suited

to this type of purulent conjunctivitis will be fully recorded under Ophthalmia Neonatorum (page 243).

In addition to the remedies there described many others have found favor with surgeons; for example, carbolic acid, $\frac{1}{2}$ to 5 per cent.; copious irrigations of a weak solution of nitrate of silver, $\frac{1}{10}$ to 1 per cent.; aqua chlorinata, peroxide of hydrogen, cyanuret of mercury, 1 : 1500; trichloride of iodine, 1 : 2000; formaldehyde, 1 : 2000, especially recommended by Valude; and probably trikresol, 1 : 2000, although experience with this drug is as yet too limited to state its value. An old remedy much depended on by some surgeons is alum, eight grains to the ounce, and recent investigations, especially in the treatment of urethral gonorrhœa, indicate that copious irrigation of a solution of permanganate of potassium, 1 : 2000, is likely to prove of definite value. This is by no means a new treatment for ophthalmic gonorrhœa, having at one time been much employed by the Vienna School. In high degrees of inflammatory action leeches may be applied to the temple, but usually it is better, when the pressure of the lids threatens to destroy the cornea, to freely divide the outer canthus. Incisions into the chemotic conjunctiva have been practised, and Fuchs and other operators have split the lid vertically and stitched the divided portions to the brow in the hope of saving the cornea from sloughing.

If corneal ulcers arise, sulphate of eserine or atropine solution, according to the directions given on page 245, should be employed.

FIG. 62.

Buller's shield (Berry).

Occasionally an ulcer may be checked by the application of the point of a galvano-cautery, but if rupture has actually occurred and the iris is prolapsed, this must not be done; neither should the prolapse be cut off, as in ordinary non-infecting cases, lest the micro-organisms gain

entrance to the deeper structures of the iris. Should the unfortunate results of staphyloma, shrunken ball, etc. ensue, the various operations elsewhere described are indicated. It is doubtful whether, in the general treatment of this disease, which should not be neglected, the old-fashioned practice of bringing the constitution under the influence of mercury is advisable. Frequently tonics—iron, strychnia, and milk punch—are necessary, and opium or morphia may be administered at night to relieve pain.

Patients with gonorrhœa should be warned of the danger of infecting their own eyes and the eyes of those who come in contact with them. When one eye alone is inflamed, the other should be protected with a Buller's shield, which consists of a watch-glass fitted accurately over the eye and held in place either with pieces of rubber adhesive plaster or, better, with strips of gauze fastened by means of liquid collodion (Fig. 62).

One form of conjunctivitis occasionally occurs during the course of a gonorrhœa which does not depend upon the gonococci of Neisser, but which develops in patients suffering at the same time with gonorrhœal rheumatism. The disease is bilateral, is often more connected with the episcleral tissues than with the palpebral conjunctiva, and usually resembles a moderate catarrhal inflammation, although it may be complicated with iritis. It has been the practice of many surgeons to give the name "gonorrhœal ophthalmia" to this affection, and reserve the term "gonorrhœal conjunctivitis" for the disease which depends upon the presence of the specific taint. There is, however, no good reason for this distinction.

Ophthalmia Neonatorum.—This type of purulent conjunctivitis is caused by the entrance of an infecting material from the genito-urinary tract of the mother during or shortly after the birth of the child, and in all severe types the gonococcus of Neisser can be found within the cells of the secretion. It is probable that inoculation may occur *in utero*. Milder types are not uncommon when there is no purulent vaginal discharge, and in which the diplococci are either entirely absent or sparsely present. These varieties are caused by careless bathing of the child and the use of soiled towels, or by contact with impure lochial discharge, healthy lochia probably being free from danger. Ophthalmia neonatorum is more common in boys than in girls, and more frequent, it is said, with face presentations and during retarded labors.

Symptoms.—The disease usually begins about the third day after birth, except when it is the result of a secondary infection, when it may be delayed much later. Practically always both eyes are affected. The slight redness of the conjunctiva rapidly gives place to intense chemosis, swelling of the lids, and the free secretion of a greenish pus. The palpebral conjunctiva is swollen, red, and velvety, and bleeds readily, while the bulbar conjunctiva is infiltrated and presses upon and overlaps the corneal margin. Later, the lids grow less tense, the conjunctiva becomes thick and granular, and slowly the discharge subsides in from six to eight weeks. Less frequently than in gonorrhœal conjunctivitis of adults, and yet very often, ulcers form, especially around the limbus, and also in the centre of the cornea, and unless they are checked all of the consequences of perforation of this membrane already described are likely to ensue (Fig. 63).

Sometimes from the very beginning the lids are covered with a false gray membrane resembling diphtheritic conjunctivitis; again, the disease may be mild in type, not more exaggerated than an ordinary catarrhal conjunctivitis. Constitutional symptoms are not infrequent, and syno-

FIG. 63.

Ophthalmia neonatorum, from a child in the Philadelphia Hospital.

vitis of the knee and wrists may arise similar to that seen during attacks of gonorrhœa in adults.

The **prognosis** is always grave, but if the eye is seen while the cornea is still clear, except in those examples which from the beginning assume a diphtheritic type and in certain other varieties which seem to possess an inherent malignancy, competent medical service should bring the case to a successful termination. The chief danger lies in failure to recognize in the early stages the serious nature of the affection, and the eye of any child which develops even the slightest type of conjunctivitis during the first few days of life should be suspected, watched, and carefully treated.

Treatment.—Many methods of managing these cases have been described. The following is the one employed by the author, and is practically that which most ophthalmic surgeons deem the best, being applicable also to the gonorrhœal conjunctivitis of adults:

(*a*) During the earlier stages, when the inflammatory swelling of the lids is great, in addition to proper cleanliness the local application of cold is the most useful agent. This should be applied as follows: Upon

a block of ice square compresses of patent lint are laid, which, in turn, are placed upon the swollen lids, and are as frequently changed as may be needful to keep up a uniform cold impression.

(*b*) The discharge should be constantly removed, if possible, by a trained hand. In order to accomplish this, proceed as follows: Gently separate the lids, wipe away the tenacious secretion with bits of moistened lint or absorbent cotton, and irrigate the conjunctival sac freely with an antiseptic solution, care being taken that the point of the pipette does not come in contact with the cornea. For this purpose a saturated solution of boric acid—which, while it is not germicidal, is still feebly antiseptic and slightly astringent—is the most useful. Bichloride of mercury, one grain to the pint, may also be employed.

(*c*) As soon as the discharge becomes free and creamy, which is very early in the disease, nitrate of silver should be employed; and this drug is *facile princeps* of the local remedial agents. It must be applied as follows: Carefully evert the lids and secure complete exposure of the inflamed tarsal conjunctiva; remove all discharge and flakes of lymph by irrigating the surfaces with the cleansing lotion, wiping away the adherent particles with moistened cotton; carefully touch the area thus prepared with a cotton mop or camel's-hair brush which has been dipped in the silver solution, ten, or at most twenty, grains to the ounce; neutralize the excess with a solution of common salt—a pinch of salt in a cup of water will suffice—and keep applying the saline solution until a clean red surface is secured; return the lids to their proper position and carefully inspect the cornea before leaving the case, and see that this inspection is made at each dressing of the eye; finally, grease the margins of the lids with pure vaseline, some of which should be introduced within the conjunctival cul-de-sac.

(*d*) If there is haze of the cornea, indicating low vitality of this structure, the cold compresses may be replaced by *hot* applications,[1] which should consist of squares of lint wrung out in a slightly carbolized solution at a temperature of 120° F.

(*e*) Should an ulcer form, eserine may be employed in a strength varying from a sixth to a half grain to the ounce, but cautiously, lest it produce iritis. Under the latter circumstance, or if the ulcer is central, atropine is the better drug, and may be used in a strength of from two to four grains to the ounce. Very good results usually follow the use of eserine two, three, or four times during the day, according to the severity of the corneal ulceration, and a drop or two of the atropine solution toward night to allay iritic and ciliary irritation. Care must be exercised to avoid constitutional disturbance from the absorption of these drugs.

As the disease declines the strength of the nitrate of silver should be lessened, and it should not be used too early nor when there is a tendency for a membranous exudation to appear on the conjunctiva. Modifications of these applications must necessarily be suggested by the exigencies of each case. The other lotions already enumerated when describing the treatment of gonorrhœal conjunctivitis (p. 242) may be tried in place of those recommended, each having its advocates. The author desires to warn against the indiscriminate use of strong solutions of

[1] It is essential that these compresses should be hot; otherwise they are valueless.

bichloride of mercury, which, he is satisfied, have not infrequently been the cause of corneal complications.

Prophylaxis.—Aseptic midwifery has fortunately lessened the number of cases of ophthalmia neonatorum, but some form of prophylaxis is advisable, and experience shows that Credé's method, certainly in hospital practice, is the one followed by the best results. This consists in the instillation of two drops of a 2 per cent. solution of nitrate of silver into the conjunctival sac of the new-born child, which, as soon as it is expelled from the maternal passages, and before the cord is cut, should be placed upon its back in the bed and the eyelids carefully cleansed, then parted, and the drug introduced. Small compresses soaked in a solution of salicylic acid are now laid upon the closed lids. Other methods depend essentially upon proper cleansing of the eye with some form of antiseptic fluid or upon rigid antisepsis during labor, although it should not be forgotten that strong solutions of bichloride of mercury may originate a vaginitis of itself capable of inducing one form of ophthalmia neonatorum.

About 70 per cent. of those who become blind during the first year of life owe their affliction to ophthalmia neonatorum. The danger is delay in the treatment, and for this reason it is a source of great congratulation that in a number of States stringent legislative regulations are in force requiring the prompt reporting of cases of conjunctivitis in newly-born children to competent medical officers. Much credit for bringing about this state of affairs belongs to Dr. Lucien Howe of Buffalo.

Pseudo-membranous or Plastic Conjunctivitis generally occurs in two chief varieties—namely, *croupous* and *diphtheritic conjunctivitis*. The former is a rare disease, occasionally seen in young children, characterized by membranous exudation which lies upon the surface of the tarsal conjunctiva. The lid is not thickened.

It may be treated with iced compresses and the frequent removal of the discharge with a solution of chloride of sodium or chlorate of potassium. Nitrate of silver should not be applied.

The second variety, or *diphtheritic conjunctivitis*, is characterized by a board-like, painful swelling of the lids, a scanty sero-purulent or sanious discharge, and an exudation or membrane, containing Klebs-Loeffler bacilli, within the layers of the conjunctiva. It is almost always attended with more or less destruction of the cornea. It is said to be epidemic in certain portions of Germany and France, and is usually seen in connection with diphtheria of the nares and throat.

The **prognosis** is most unfavorable.

Treatment.—The treatment is similar to that of ophthalmia neonatorum, except that nitrate of silver is of doubtful value. Fieuzal commends the application of lemon-juice, which is afterward washed away with a 2 per cent. solution of nitrate of silver. Tweedy advises solutions of quinine, which have also been recommended in gonorrhœal ophthalmia. Valude condemns cold compresses, nitrate of silver, and sublimate lotion, believing that the essential basis of the treatment should consist of antiseptic sprays, followed by the application of iodoform salve; while Sourdille washes the conjunctiva with biniodide of mercury, 1 : 20,000, removing the false membrane with a solution of

biborate of sodium, and touching all the affected areas of the conjunctiva with a cotton mop dipped in a preparation composed of five drachms of glycerin and half a drachm of carbolic acid. In the interval he employs a salve of methyl-blue, 1 : 1000, because it is stated that Löffler's bacillus does not grow in bouillon containing pyoktanin even in very minute proportions. Both of these authors commend the lemon-juice applications.

The constitutional treatment of diphtheria, especially small doses of mercury, is valuable. Hot compresses are useful. Recently diphtheria antitoxin has been recommended.

Follicular Conjunctivitis consists in the development of numerous pinkish or rounded elevations in the conjunctiva, chiefly occurring in the retrotarsal folds in connection with an ordinary catarrhal discharge. These bodies are tumefied lymph-follicles, which some writers regard as an early stage of true granular conjunctivitis or trachoma. The author believes they represent an entirely distinct disease. Common in children surrounded by bad hygienic environment, a mild form of the disease is not infrequent in those who are in perfect health. When, however, it develops in schools, asylums, etc., it may become epidemic and readily accept the contagion of true trachoma.

Treatment.—The treatment should consist in the correction of refractive errors and the removal of the tumefied lymph-follicles. The latter is best done by destroying them with some form of expression-forceps, especially the models devised by Dr. Noyes and Dr. Knapp. Locally, the ordinary treatment of conjunctivitis previously described is indicated. Fortunately, corneal complications do not occur, and the bodies disappear without leaving scars—a fact which separates this disease sharply from trachoma.

Granular Conjunctivitis (Granular Ophthalmia, Egyptian Ophthalmia, Military Ophthalmia, Trachoma).—In this inflammation there are formed in the conjunctiva rounded "granulations" or "trachoma-bodies," which after absorption leave cicatricial changes. It is usually studied under two forms—*acute* and *chronic* granulations.

Causes.—The acute granular conjunctivitis may arise under the influence of imperfect hygienic surroundings, especially in asylums where the inmates are crowded together. It is a distinctly contagious disease, and rapidly spreads from one eye to another.

Chronic granulations may result because the acute disease has failed to disappear, but more frequently are a primary disorder. While they may appear in people of depraved nutrition, they not uncommonly attack those who are in good health. Certain races are predisposed to the disease, particularly the Jews, Irish, Italians, Poles, the inhabitants of the East, and the Indians of our own country. Pure negroes are almost exempt. The disease is most common in damp climates and low-lying regions, an altitude of one thousand feet conferring comparative immunity. The specific cause of trachoma is supposed to be a special form of micro-organism, the trachoma-coccus, although it has not been definitely isolated. The secretion from the conjunctiva is contagious, and will produce a disease like the one from which it came.

The granulations, which should not be confounded with wound-granulations, and hence are more properly designated the trachoma-

bodies, are the essential characteristics of the disease. According to some writers, they should be regarded as new growths of special pathological character; according to others, they are the derivatives of the natural lymphatic follicles. The former view is the one which the author believes possesses the weight of evidence in its favor.

The following varieties of chronic trachoma are recognized:[1]

(*a*) *Papillary trachoma*, in which the trachoma-bodies or follicles (granulations) are scant and are hidden by hypertrophied conjunctival papillæ.

(*b*) *Follicular trachoma*, in which the spawn-like granulations or follicles are the chief characteristic.

(*c*) *Mixed or diffuse trachoma*, in which the follicles or granulations lie along the inflamed papillæ, but are not hidden by them.

(*d*) *Cicatricial trachoma*, in which the granulations are in abeyance and the scar-tissue prominent, the cornea being more or less opaque.

The granulations, for the most part confined to the palpebral conjunctiva, especially the retrotarsal fold, but occasionally seen in the caruncle and plica, are gray-white or reddish bodies, described variously as sago-grain, frog-spawn, and vesicular granulations (Fig. 64). They arise insidiously. At first there is little secretion, but as the disease progresses they soften, the conjunctival papillæ are thickened, and there is much irritation and muco-purulent discharge. New follicles take the places of those which have broken down and disappeared, and gradually scar-tissue forms, gray-white lines intersecting the remains of old granulations being apparent on eversion of the lids. As the result of this process the sequels of granular lids develop. These are—

FIG. 64.

Granular lids (Jones).

(1) *Pannus*, which is a form of vascular keratitis consisting in the development of blood-vessels in the superficial layers of the cornea, chiefly beneath the upper lid, either moderate in degree or thick and fleshy (fleshy pannus). This is partly the result of a mechanical action from the friction of the roughened lids, and partly an implantation of the diseased process within the corneal layers (Fig. 65).

(2) *Trichiasis*, *Distichiasis*, and *Entropion*. (See page 283).

(3) *Xerosis*, or *drying of the conjunctiva*, which may result in entire obliteration of the conjunctival sulcus.

Prognosis.—The prognosis is unfavorable in so far as the duration of the disease and the vision of the patient are concerned. Relapses are frequent, and when trachoma becomes an epidemic in armies, schools, prisons, barracks, and the like, it presents one of the most serious of ophthalmic problems. Fortunately, modern methods of treatment have greatly improved the chances of the afflicted and shortened the duration of this very tedious disease.

[1] As Knapp has shown, a broad distinction between inflammatory and non-inflammatory trachoma should be recognized.

Treatment.—The treatment of acute granulations does not materially differ from that of acute conjunctivitis, and it is a well-established surgical law that the operative measures so valuable in the chronic disease are not indicated in this form. The best local applications for

FIG. 65.

Trachoma and pannus (Berry).

chronic granulations, and for acute cases after the subsidence of active inflammation, are as follows:

1. Nitrate of silver in a strength varying from five to twenty grains to the ounce, and applied with the same precautions described in connection with Purulent Conjunctivitis, provided the disease is associated with purulent or muco-purulent discharge and there is much swelling of the conjunctival papillæ and ulceration of the trachoma-bodies.

2. Bichloride of mercury, 1 : 300 or 1 : 500, applied to the everted lids with an absorbent cotton mop once a day or several times a week, according to the amount of reaction, the conjunctival cul-de-sac being frequently irrigated with a tepid solution of the same drug, 1 : 8000, provided there is considerable lymphoid infiltration and prominence of the granulations, unassociated with any considerable muco-purulent discharge.

3. A smooth crystal of sulphate of copper carefully applied once a day to all the affected areas, especially the retrotarsal folds, particularly valuable when the signs of beginning cicatricial change are apparent, although a useful application, and perhaps the most useful of all local applications in any stage of the disease, except when there is high inflammatory reaction and much swelling of the conjunctival papillæ and purulent discharge.

4. Boroglyceride, 30 to 50 per cent., or tannin and glycerin, 30 to 60 grains to the ounce, useful in practically any stage of the disease when a mild astringent is desired, but especially valuable in the later stages, when there is a tendency to xerosis of the conjunctiva.

These four remedies the author considers the best of the medicinal

applications, although there is scarcely an astringent or antiseptic substance that has not been employed with the hope of causing absorption of the granulations. The following may be mentioned: Liquor potassii; iodoform and aristol in powder and salve; calomel; an ointment of the yellow oxide of mercury; carbolic acid, which Collins employs in its pure state; resorcin, 1 to 3 per cent. solution put up with glycerin; betanaphthol in the form of a salve; chromic acid, when the granulations are leather-like in consistence; quinine in the form of a collyrium or as a powder; massage of the affected areas with various powders, particularly boric acid; iodide of silver, especially in the nascent state; and berberin and hydrastin, the latter in 2 to 5 per cent. aqueous solution. Frequent cleansing of the conjunctival cul-de-sac should be practised with any mild antiseptic solution that is suitable for ocular application. If during exacerbations of the disease ulcers form in the cornea, these must receive the treatment applicable in general to ulceration of this tissue. (See p. 253.)

Pannus will usually subside with the disappearance of the disease of the lid; if it does not, a spray of a weak solution of sulphate of copper directed against the cornea is sometimes efficacious. The operation of *peritomy*, which consists in the excision of a small strip of conjunctiva surrounding the margin of the cornea, as well as several modifications of this operation, is occasionally efficacious, although not now practised as frequently as in former days.

Inveterate thick and fleshy pannus in former times was treated by inoculating the conjunctiva with blennorrhœic pus, and thus causing a violent acute conjunctivitis. As a substitute for this De Wecker recommended *jequirity*, an active conjunctivitis of a somewhat membranous type being produced by painting the everted lids once or twice a day with a 3 per cent. infusion of this drug. When first introduced it was looked upon as a panacea, but its widespread and often reckless application was the cause of the loss of more than one eye. If used at all—and in the opinion of the author its dangers are great and its value exceedingly limited—stubborn pannus without ulceration, and when all other reasonable methods have been tried, furnishes its only indication. A few surgeons continue to believe in its efficacy, and some—for example, Cheatham of Louisville—employ the powdered drug placed directly upon the area of granulation it is expected to destroy.[1]

Operative procedures for the cure of trachoma, which are fully described elsewhere, yield the best results in the greatest number of cases, but even after their performance medicinal applications may be needed. As many of the patients with granular lids are in feeble health, tonics, change of air, and all suitable hygienic measures, particularly when the disease attacks the inmates of crowded institutions, are most important. Residence in a high altitude is desirable.

Chronic Conjunctivitis may be the result of an imperfectly cured acute attack or manifest itself as an aggravated hyperæmia. Applica-

[1] It would be impossible in the space allotted to refer to the enormous number of drugs which have been used to cure granular lids. Those interested in the literature are referred to Professor Sattler's monograph *Die Trachombehandlung einst und jetzt*, Berlin, 1891, and to the author's article on "Diseases of the Conjunctiva, Sclera, and Cornea," Hare's *System of Practical Therapeutics*, vol. iii. p. 948.

tions of mild astringents, particularly tannin and glycerin, are useful, but the best results are obtained by treating the nares, which are almost always more or less affected, correcting any refractive error and dilating the lachrymal puncta, and washing out the canal with an antiseptic fluid.

One of the types of chronic conjunctivitis is known as *lachrymal conjunctivitis*, and depends upon the irritation caused by the imperfect passage of the tears through the lachrymo-nasal duct.

Toxic Conjunctivitis is caused by the frequent application of atropia or other mydriatics, less commonly of the myotic drugs, to the conjunctival cul-de-sacs of persons predisposed to the inflammation, especially when the solutions are impure. The disease somewhat resembles a follicular conjunctivitis, and is cured by ceasing the use of the mydriatic or myotic and applying a mild astringent—for example, an alum crystal.

Ecchymosis of the Conjunctiva is an extravasation of blood in the meshes of the subconjunctival connective tissue, and appears as the result of an injury, a violent straining effort—for example, a paroxysm of whooping cough—during conjunctival inflammations, and sometimes without obvious cause, particularly in old people, although it may indicate chronic nephritis. It requires no treatment. It is an important symptom in fracture of the skull.

Chemosis, or Œdema, of the Conjunctiva, occurs when the connective-tissue layer is distended with serum. It is a symptom of acute conjunctivitis, and is often seen in association with iritis, choroiditis, and orbital cellulitis.

Emphysema of the Conjunctiva consists of a distention of the connective-tissue spaces with air, and is practically always due to injury, especially fractures of the orbit or of the nasal bones.

Diseases of the Cornea.

The term "keratitis" is applied to various types of inflammation of the cornea, and the pathological processes involved include cellular infiltration, ulceration, abscess-formation, and the appearance of vesicles in the corneal layers. The following are the most important varieties of keratitis:

1. Phlyctenular Keratitis (Phlyctenular Kerato-conjunctivitis), is characterized by the formation of single or multiple subepithelial collections of round cells, usually appearing at or near the corneo-scleral junction, which are variously called vesicles, pustules, or pimples, and is associated with lachrymation and much blepharospasm and photophobia. The phlyctenules soon break down and form ulcers. Relapses are frequent.

Cause.—The disease is common in children, and not unknown in adults, often appearing after the exanthemata and with eczema of the face, and is more frequent in persons of a strumous constitution, especially when they live in imperfect hygienic surroundings, or are permitted to indulge in unsuitable diet. Perhaps the most frequent causes of the disease are various types of obstructive and inflammatory lesions in the nasal passages. Almost always there is an associated rhinitis, and examination will reveal tumefied turbinals and adenoid vegetations.

A good many varieties of the disease exist, the most important being the so-called *fascicular keratitis*, in which the phlyctenular ulcer creeps, as it were, across the cornea, dragging after it a leash of injected blood-vessels. Sometimes the phlyctenules completely surround the corneal margin, and the disease receives the name *marginal keratitis*. Occa-

FIG. 66.

Pustular eczema of the face and phlyctenular kerato-conjunctivitis, illustrating the intense photophobia, from a child in the Children's Hospital.

sionally a phlyctenule is so large that it is called a pustule, and then becomes an exceedingly dangerous corneal lesion (Fig. 1, Plate I.).

Treatment.—This includes regulation of the diet; tonics, particularly iron, quinine, arsenic, cod-liver oil; thorough examination and treatment of the rhinopharynx, as well as scrupulous attention to the patency of the lachrymo-nasal passages; and atropine drops and a warm solution of boric acid during the early stages. Later, the ulcer may be stimulated with the yellow-oxide-of-mercury salve, a grain to the drachm, or with finely-powdered calomel, provided the patient is not taking iodide of potassium. If the blepharospasm is not relieved by these measures, douches of cold water are serviceable, and if there is a crack or fissure at the external commissure, it should be divided precisely as would be done with a fissure in ano. After the inflammation has entirely subsided, refractive error should be corrected with suitable glasses.

ULCERS OF THE CORNEA.—These are either primary—that is, the disease starts in the cornea itself—or they are secondary to some other disease—for example, conjunctivitis. The disease just described furnishes the greatest number of ulcers of the cornea in childhood. The others, according to their character, are known as—

1. *Simple, or Small Central Ulcer*, which appears as a gray or grayish-white lesion in the centre of the cornea, associated with very little inflammatory reaction, common in children, and due either to rupture of a phlyctenule, trauma, or depraved nutrition.

PLATE I.

Fig. 1.

Fascicular Keratitis. (Berry).

Fig 2

Hypopyon Keratitis. (Berry).

(To face page 252.)

Treatment.—It usually yields readily to mild treatment—atropine drops for a few days, followed later by stimulation with the yellow-oxide ointment. If neglected it may turn into a serious lesion.

2. *Purulent or Deep Ulcer* is characterized by an area of yellowish infiltration surrounding the corneal ulceration, and has a distinct tendency to penetrate and perforate the cornea. It is not infrequently associated with hyperæmia or even inflammation of the iris. It may be primary and caused by an injury, or secondary to conjunctival inflammation.

3. *Infecting or Sloughing Ulcer*—or, in other words, *purulent keratitis*—is an aggravated type of the previously described condition. There are many varieties, the most characteristic one being the *acute serpiginous* or *creeping ulcer* of Saemisch. This frequently central lesion has sharp margins. One, yellower in color than the rest and known as the arc of propagation, spreads rapidly, and soon the deeper structures are involved —iritis, irido-cyclitis, and pus in the anterior chamber being the result.

Sloughing ulcers are caused by local infection, a small abrasion of the cornea often forming the nidus of the microbic elements that are probably active. One variety depends upon a special fungus. A frequent association with sloughing ulcers is purulent disease of the larchrymo-nasal passages, the highly contagious pus from which bathes the surface and constantly adds to the infection.

Hypopyon, or *pus in the anterior chamber*, is the frequent accompaniment of these sloughing ulcers. It may be merely a line of infiltration, or a collection so copious that it nearly fills the entire chamber. Sometimes it is fluid, and sometimes it partakes of the nature of a slough (Fig. 2, Plate I.). It should be distinguished from—

Abscess of the Cornea.—This is a purulent infiltration within the layers of the membrane itself, caused by inoculation with the micro-organisms of suppuration, over which the epithelium remains at first unbroken. As the abscess grows, however, the overlying tissue often ruptures, and an open lesion identical in character, though greater in extent, with a sloughing ulcer, results. Abscess may be primary, or it may be secondary to a conjunctival inflammation. Certain types depend upon simple malnutrition: one variety, in the form of a ring-abscess, described as *kerato-malacia*, is seen in prolonged illness, especially when there is diarrhœa or dysentery. Septic processes, either local or general —the former, for example, after operative interference, now fortunately rare—are responsible for some abscesses of the cornea, and the suppurative keratitis occurring in the convalescent stages of small-pox has occasioned the loss of many eyes.

The Treatment of Deep and Sloughing Ulcers.—This includes atropine or eserine (for which hydrochlorate of pilocarpine in double strength may be substituted), according to the rules laid down on p. 245; the frequent application of hot compresses (120° F.); and irrigation of the conjunctival cul-de-sac with mild antiseptic collyria—boric acid, bichloride, 1 : 10,000, aqua chlorinata—and of the lachrymal passages with the same fluids, preceded, if necessary, by free division of the canaliculus. Impending perforation of the cornea may often be checked by the application of a compressing bandage, changed as frequently as necessary to allow the application of the local remedies, and contraindicated only when there is much catarrh of the conjunctiva or an eczema

of the lids. If the lesion continues to spread, the anterior chamber may be tapped with an ordinary paracentesis needle, thrust, if possible, through the base of the ulcer. The following measures are recommended in the event of failure with the methods thus far described:

(1) Thorough curetting of the ulcer with a sharp spud, followed by pencilling its edges with sublimate lotion, 1 : 2000, or dusting iodoform upon its surface. Nitrate of silver and carbolic acid are also useful: the former, in the strength of ten to twenty grains to the ounce, is applied directly to the seat of ulceration, which, according to the amount of infiltration, has or has not been prepared for the reception of the drug by previous curetting; the latter, in its pure state, is applied with a probe, care being taken to touch only the affected area.

(2) The application of the actual cautery, for which purpose a small Paquelin or galvano-cautery needle may be employed. In the absence of either of these instruments a platinum probe heated in an alcohol flame will answer the purpose. The exact area to be cauterized is ascertained by dropping upon the ulcerated surface a 2 per cent. solution of fluorescine, which colors green all portions of the cornea denuded of epithelium.

(3) The subconjunctival injection of bichloride of mercury in the neighborhood of the ulcer, two minims of a 1 : 2000 solution being introduced beneath the conjunctiva by means of a Pravaz syringe, and repeated as often as is permissible by the amount of reaction produced, one injection every day or second day usually being sufficient. The author has seen these injections act very well in a few cases, although he does not employ them or recommend them with the same confidence as many French surgeons, particularly Darier; indeed, in some cases their action has been harmful.

(4) If an abscess of the cornea is unbroken, its anterior wall may be incised and the subsequent treatment carried on in the manner just described. If the abscess has burst, or if there is much pus in the anterior chamber (hypopyon keratitis), the chamber should be evacuated, either by paracentesis of the cornea, as before noted, or by Saemisch's section—*i. e.* by dividing this lesion with a cataract knife through its entire length.

In every case of corneal ulcer the associated conditions which are likely to be present must be carefully sought out and treated; for example, foreign bodies, misplaced cilia, unhealthy lachrymal passages, disease of the rhinopharynx, and carious teeth. Constitutional measures should never be neglected: tonics, particularly cod-liver oil, iodide of iron, the tincture of the chloride of iron, quinine, and arsenic; nor should the removal by medicinal or dietetic means of any dyscrasia—rheumatism, gout, etc.—be forgotten. Severe pain may be alleviated by opium or morphia.

Other types of corneal ulcer which may be referred to are the so-called *ulcus rodens*, or creeping ulcer of Mooren, more commonly seen in elderly subjects, and probably best checked by the actual cautery; a lesion which is analogous to the circular or marginal ring ulcer; and *dendriform ulcers*, or furrow-keratitis, so called on account of their shape. They probably depend upon a micro-organism, although sometimes they are due to malaria and other causes not yet well understood.

The Sequels of Corneal Ulcers.—Every lesion of the cornea is followed by some opacity, although, fortunately, this is sometimes so slight that its effects are insignificant. Small spots or areas of haze are called *nebulas* and *maculas;* dense scars, *leucomas.* The last are either adherent or non-adherent according as there has or has not been perforation of the cornea and adherence of the iris to the scar-tissue.

When a cicatrix which follows an extensive corneal ulceration, and to which the iris is adherent, bulges forward, it receives the name of *staphyloma*, being *total* when the entire cornea is involved, and *partial* when only a portion is included.

Treatment.—A partial staphyloma may sometimes be reduced by the continuous application of a pressure bandage and the instillation of eserine. Should this fail, surgical measures are indicated.

In nebulous conditions of the cornea very decided improvement in vision will follow conscientious *massage* with an ointment of the yellow oxide of mercury, a grain to the drachm. A small portion of the salve is introduced beneath the lid, and rubbing movements are made over the surface of the cornea in a circular and radial direction, the séance lasting from a minute to a minute and a half. It is useless if the scars are at all dense.

Galvanism, recently advocated by Alleman, has been employed for the removal of corneal scars.

Interstitial Keratitis, often called *Syphilitic, Inherited,* or *Parenchymatous Keratitis,* is a frequent manifestation of hereditary syphilis (60 to 70 per cent. of the cases). Occasionally it is the result of acquired syphilis, and may also be due to rachitis, scrofula, malaria, rheumatism, and depressed nutrition. The disease, most frequent between the ages of five and fifteen and rare after thirty, is a diffuse keratitis, in which the entire cornea becomes involved, until, usually without ulceration, it passes into a condition of opacity, which from its appearance has been compared to ground glass, while its upper portion is thickly set with blood-vessels of a dull red color—the "salmon patch of Hutchinson" and the "vascular keratitis" of other writers. Not uncommonly the iris and ciliary body are involved in the inflammation, and frequently the deeper layers of the eye. Sooner or later both eyes are affected, sometimes many months elapsing between the attacks. The disease is essentially chronic, requiring from six to eighteen months before it yields to treatment.

The **treatment** consists, in the earlier stages, of the administration of mercury, preferably, in the opinion of the author, by inunctions. In recent times the subconjunctival injections of mercury have been used in this disease. The pupils should be kept dilated with atropine until all signs of congestion have subsided, when the remaining opacity may be stimulated to absorption by the local use of a salve of the yellow oxide of mercury applied in the manner previously described.

Neuro-paralytic Keratitis is an ulceration of the cornea which is seen in cases of paralysis of the ophthalmic branch of the trigeminus. It is probably the result of disturbed nutrition, hence a dystrophic process, aided by the loss of sensation, which causes the patient to disregard the irritating action of foreign substances on the cornea. It is a form of ulceration which is of great importance, especially in relation to certain modern operations; for example, excision of the semilunar ganglion. It

is best treated, in addition to the usual remedies for corneal ulceration, by keeping the affected eye in a warm and moist atmosphere or by careful antiseptic bandaging, and may probably be prevented or checked in its earlier stages by temporarily stitching the lids together.

KERATITIS PUNCTATA, characterized by a deposit of opaque dots arranged in a triangular manner upon the posterior elastic lamina of the cornea, and frequently associated with disease of the iris, ciliary body, choroid, or vitreous, is really a symptom rather than a separate disease, and will be referred to again in connection with Iritis (Fig. 67).

FIG. 67.

Keratitis punctata (Nettleship).

HERPES OF THE CORNEA, independently of that lesion which has been described with herpes zoster ophthalmicus, occurs in the form of a series of transparent vesicles, often placed in a circle or running diagonally. It is seen with disease of the upper respiratory tract and with various fevers, particularly those in which herpes of the lips and nose are common, but may occur without such association. It should not be confounded with phlyctenular keratitis. The pain is usually great, and the irritation marked.

The **treatment** consists in the cautious use of atropine, followed later by stimulating substances—for example, calomel. Eserine often acts well, and it may be necessary to check the development of the herpetic spots by the careful application of the actual cautery.

There are numerous other types of keratitis—for example, *keratitis bullosa*, *keratitis profunda*, *keratitis superficialis punctata*, *keratitis marginalis*, and *ribbon-like keratitis*—the characters of which are evident from the descriptive names. They are, as compared with the other types, unusual, and for their full consideration the reader is referred to systematic works on ophthalmology.

DISEASES OF THE SCLERA.

There are two types of inflammation which affect the episcleral and the scleral tissue, and according to their nature they may be *superficial* or *deep*, *acute* or *chronic*, *diffuse* or *circumscribed:*

1. EPISCLERITIS, which is really an inflammation of the episcleral tissue, appears in the form of dusky-red subconjunctival swellings, usually in the ciliary region on the temporal side of the cornea, but often located elsewhere. Relapses are very frequent, and new spots may appear, which after absorption leave dull, discolored areas.

Inflammation of this character may be caused by exposure to inclement weather, rheumatism, menstrual derangements, and probably by insufficiencies of the ocular muscles.

The **treatment** should consist in the use of atropine for a time to prevent the tendency to iritis. Later, especially in the subacute types, eserine and pilocarpine drops, one-fourth to one-half grain to the ounce, are preferable. Still later the eyeball may be massaged with the aid of the yellow oxide of mercury. Subconjunctival injections of bichloride of mercury, cyanuret of mercury, and salicylic acid are sometimes wonder-

fully efficient. The internal remedies should consist, according to circumstances, of salicylic acid, iodide of potash, salol, or iron. Diaphoresis with either jaborandi or with Turkish baths is advisable. Errors of refraction and muscular anomalies should be corrected.

2. Scleritis is the name given to a deeper inflammation of the same tissue, and appears in the form of a more diffuse, bluish-red injection, or sometimes in circumscribed patches somewhat elevated and of a violaceous tint. Almost always the deeper structures are involved, and there is an associated iritis or irido-cyclitis.

This deep scleritis may be due to cold, rheumatism, gout, scrofula, disturbances of the sexual apparatus, anomalies of menstruation, and also to syphilis (*gummatous scleritis*). There is one form seen with gonorrhœa, especially when this has caused a synovitis. It is a serious disease, and not readily amenable to the ordinary remedies. The cornea may become opaque and the sclera thinned and bluish-colored. Various irregular bulgings or scleral staphylomas may form.

The **treatment** is very much the same as that already recommended in the milder form of the affection. It should be applied with the understanding that the disease is much more serious, and that its tendency to relapse is equally great.

Diseases of the Iris.

The Pupil.—The average diameter of the pupil is about four millimetres, although it varies according to the intensity of the light and the influence of accommodation and convergence.

In order to test the mobility of the iris, one eye is occluded, and with the other the patient, placed before a window, is directed to look into the distance. The exposed eye is then shaded, when a considerable dilatation of the pupil will occur. On removal of the covering hand a contraction equal to that which existed before the test will take place. This is the *direct reflex action of the pupil.* During this examination the other pupil will act in unison with its fellow. This is the *consensual* or *indirect reflex action of the pupil.* The contraction of the pupil occurring under the circumstances detailed is a reflex phenomenon, the optic nerve being the afferent pathway and the oculo-motor the efferent nerve, communicating fibres between the corpora quadrigemina and the centre for the third nerve enabling the reflex to take place. When the eyes are directed to a near object by an effort of convergence, the pupils contract. This is the *associated action of the pupil.*

Mydriasis, or dilatation of the pupil, occurs in glaucoma, optic-nerve atrophy, orbital disease, and under the influence of mydriatics; also under the influence of emotions, depressed nervous tone, insufficiency of circulation, and irritation of the sympathetic nerve. Dilatation of the pupil, of cerebral origin, indicates an extensive lesion; of spinal origin, irritation of the part.

Myosis, or contraction of the pupil, appears in congestions of the iris, in fever, in venous obstruction of pulmonary or cardiac origin, in paralysis of the sympathetic, and under the influence of myotics. Cerebral irritation—for example, meningitis—causes contraction of the pupil, and the same phenomenon is produced by depression or paralysis of the spinal cord.

Certain lesions of the spinal marrow are associated with a peculiar pupil to which the name Argyll-Robertson is applied. It is most often seen in locomotor ataxia and paretic dementia. The pupil is either small (spinal myosis) or of ordinary size, and frequently unequal. It does not contract when light is directed upon the retina, but the usual associated action is present; that is, during convergence or accommodation.

Another important pupillary phenomenon is that seen when there is *hemianopsia*, or obliteration of one-half of the visual fields. If, under these circumstances, when light is thrown upon both the blind and the seeing side of the retina, the usual contraction of the pupil takes place, the lesion which has caused the hemianopsia is posterior to the primary optic centres. If, on the other hand, there is no contraction of the pupil when the ray of light falls upon the blind side of the retina, although the usual contraction takes place when it is directed upon the seeing side, the lesion which has caused the hemianopsia is in the chiasm or in the tracts. This phenomenon is known as the *hemiopic pupillary reaction*, or *Wernicke's symptom*. It is of the utmost importance as a localizing symptom, especially in connection with cerebral surgery.

Unequal Pupils are rare in health, but common in cerebral disease and focal brain-lesions, and of great frequency in tabes, disseminated sclerosis, and paretic dementia. They also occur in eyes with widely dissimilar refraction, if one eye is blind, in aneurysm, dental disease, and traumatism.

Hippus is an alternate contraction and dilatation of the pupil, and is a normal phenomenon in moderate degree, but when excessive is seen in certain nervous diseases, particularly hysteria, and in some varieties of insanity. In the latter complaint there is often a varying inequality of the pupils, and this of itself may be a prodrome of certain types of this disease.

Irido-donesis, or tremulous iris, is an oscillation of the iris depending upon want of support, and is seen, for example, in dislocation of the lens and frequently after the extraction of a cataract.

Persistent Pupillary Membrane is a vestigial remnant of the fœtal covering of the lens, and consists of delicate cords passing across the pupil. They may be mistaken for iritic adhesions due to inflammation.

The remaining important congenital anomalies of the iris are *corectopia*, or an eccentric position of the pupil; *polycoria*, or a multiplicity of pupils; and *coloboma*, or a fissure of the iris which in a general way resembles an artificial pupil; and finally, *irideremia*, or congenital absence of the iris.

Iritis.—This is the general term which is applied to inflammations of the iris. It may be *acute* or *chronic*, and, according to its pathological nature, *plastic*, *parenchymatous*, or *serous*, while, according to its supposed etiology, it is divided into *syphilitic*, *rheumatic*, *gouty*, *gonorrhœal*, *diabetic*, *tubercular*, *scrofulous*, *cachectic*, *idiopathic*, *traumatic*, *sympathetic*, *and secondary iritis*.

Symptoms.—The following symptoms are common to practically all varieties of iritis: Change in the color of the iris; pericorneal injection (ciliary congestion); myosis and immobility of the pupil, the latter being due to the formation of inflammatory attachments between the iris and the capsule of the lens, forming the so-called *posterior synechiæ*; irregu-

larities in the surface of the iris, due to the accumulation of exudate; haziness of the cornea; and more or less turbidity of the aqueous humor.

The subjective symptoms are violent pain, especially at night, disturbance of vision, tenderness of the globe, photophobia and sometimes fever, nausea, and marked depression. If a mydriatic is instilled into an eye suffering from iritis, there is irregular dilatation of the pupil, certain points of the margin of the iris being held by the synechiæ.

FIG. 68.

Various forms of synechiæ (Sichel).

Diagnosis.—Immobility of the pupil and the attachment of its margin to the capsule of the lens by the synechiæ distinguish iritis from all types of conjunctivitis. Acute glaucoma, which resembles it in many points, should at once be differentiated by the fact that, although the pupil is immobile in glaucoma, it is dilated, while in iritis, although also immobile, it is contracted. The increased tension in the former disorder is an additional distinguishing point.

Simple Plastic Iritis, common in syphilis, occurring usually between the second and ninth month after the initial lesion, sometimes as late as the eighteenth month, is not, like the true syphilitic type, diagnostic of the disease. Next to syphilis, rheumatism is responsible for the greatest number of cases, perhaps the only difference between the two being that in the rheumatic types relapses are more frequent and the pain is greater. The same may be said of gout.

Gonorrhœal Iritis is a rare form which usually does not coincide with nor follow the gonorrhœal attack; an arthritis of the knee and sometimes of the ankle may intervene. Other types of plastic iritis have already been referred to on page 258.

Treatment.—The local treatment of plastic iritis consists in the persistent use of atropine, four grains to the ounce, the frequent application of moist or dry heat to relieve the pain, and leeches to the temple. Ordinarily the best constitutional remedy is mercury, preferably administered by inunction. The author has never been able to persuade himself that hypodermic injections of mercury have proved their advantage over the older methods of administration, but when the disease is not too acute subconjunctival injections of bichloride of mercury produce good results in many cases. If there is rheumatism or gout, the constitutional remedies for these diseases should be exhibited, particularly the salicylate of soda; iodide of potassium is always useful, and may be combined with small doses of mercury. Occasionally, especially in gonorrhœal iritis, hypodermics of pilocarpine afford prompt relief.

Parenchymatous Iritis is characterized by the usual symptoms already described, added to which there are distinct swellings in the iris, owing to cellular proliferation. The most important type is—

True Syphilitic Parenchymatous Iritis (often called *gummatous iritis*, but more properly *iritis papulosa*).—This occurs in the later secondary stages of syphilis, and is characterized by the formation of yellowish, reddish-yellow, or reddish-brown nodules situated at the pupillary or ciliary border and occasionally between the two in the iris-tissue. *True gumma of the iris* appears in the so-called tertiary period of syphilis, or that period in which gummata in other organs are found, and usually occurs as a yellowish-white lesion near the ciliary border (Fig. 69).

FIG. 69.

Gummatous iritis, from a patient in Philadelphia Hospital.

The **treatment** of true syphilitic iritis does not differ from that already described.

Serous Iritis.—This disease has certain features which distinguish it from the two other types already described, chiefly because there is apt to be some deepening of the anterior chamber and slight dilatation of the pupil, while on the posterior layer of the cornea there is a triangular precipitate of opaque dots, already referred to under Keratitis Punctata. (See page 256.) It may be caused by syphilis. It is more common in women than in men, and especially frequent in connection with pelvic disorders, anæmia, etc.

The usual **treatment** is applicable, except that atropine must be used with caution, lest it cause a rise of tension and symptoms of secondary glaucoma. In this event—as, indeed, in any form of iritis in which this phenomenon occurs—paracentesis, or even iridectomy, may be needed.

Traumatic Iritis occurs as the result of an injury, either accidentally inflicted or from operative interference.

The **treatment** does not differ from that already detailed, except that the need for constitutional measures is not so evident, while iced compresses may be locally applied—a method not suited to other types of iritic inflammation.

The term *secondary iritis* is given to that form of inflammation which appears in connection with other diseases of the eye—for example, scleritis, ulcers of the cornea, etc.; while *idiopathic iritis* is the type which is seen when neither local injury nor constitutional disease is present. It is often ascribed to cold.

Chronic Iritis.—This name is given to any type of iritis which assumes a chronic course, and is sometimes applied to a destructive type of iritis seen in adults, which is really a plastic irido-choroiditis. One form of insidious iritis, active inflammation being practically absent—the "quiet iritis" of Hutchinson—may be due to syphilis, sympathetic inflammation, or rheumatism.

ANOMALIES OF THE ANTERIOR CHAMBER.—These may consist in alterations in its depth; for example, when it is deepened in luxation or absence of the lens, serous iritis, cyclitis, and certain forms of staphyloma, or when it is shallower than normal—*e. g.* in chronic iritis, glaucoma, and growths in the interior of the eye. Secondly, there

may be alteration in its contents owing to the presence of pus (hypopyon) or blood (hyphæma). Finally, there may be foreign bodies in the anterior chamber; for example, a chip of steel which has penetrated the cornea, a cilium which has passed though a wound in the same situation, or even parasites, as the cysticercus and filaria sanguinis hominis.

CYCLITIS, or inflammation of the ciliary body, is divided into a *plastic*, *serous*, and *suppurative* type. The most prominent symptoms are œdema of the upper lid, tenderness of the globe, pericorneal injection, turbidity of the aqueous humor, grayish points of lymph upon the posterior layers of the cornea, exudation into the posterior chamber causing a pushing forward of the iris, complete posterior synechiæ, and opacity in the vitreous humor. It is uncommon to see a pure cyclitis, the disease, always of graver import than pure iritis, usually being an irido-cyclitis or part of a process which involves the entire uveal tract—namely, the choroid and iris.

The common **causes** of cyclitis are injuries, which are the most frequent antecedents of the purulent type of the disease; syphilis, sometimes manifesting itself in the form of a *gummatous irido-cyclitis* (Fig. 70); gout; and rheumatism.

The **treatment** consists in the remedies already recommended in connection with Iritis, except when there is purulent disease of the ciliary body. Then the surgical measures which will be described in connection with sympathetic disease are demanded.

FIG. 70.

Gummatous irido-cyclitis, from a patient in the Philadelphia Hospital.

DISEASES OF THE CHOROID.

CHOROIDITIS.—This is the general term applied to the various idiopathic, sympathetic, and traumatic inflammations of the choroid coat.

Symptoms.—Externally there are no symptoms characteristic of the disease. With the ophthalmoscope, according to the stage, may be seen hyperæmia, absorption of the retinal pigmented epithelium, patches of yellow tint, plaques of white color due to atrophy of the elements overlying the sclera, which is thus exposed, and masses of black pigment in heaps or bordering the atrophic patches.

As secondary results there may be opacities in the vitreous and lens. The retina is frequently involved (retino-choroiditis).

The disease may be acute or chronic, deep or superficial, exudative or suppurative, and there are numerous varieties, the most important being the deep or *diffuse exudative choroido-retinitis*, characterized by large plaques of atrophy and much heaping and disturbance of the pigment, and *disseminated choroiditis*, in which the atrophic spots assume a round or oval shape, bordered with dark pigment, and are scattered over the fundus.

Cause.—Numerous cases are due to syphilis, and appear from six months to two years after the initial lesion. Other causes are gout, anæmia, scrofula, tuberculosis, heredity, and injury.

Choroiditis in the region of the macula is called "central," and may be found in various types (senile, areolar, guttate, etc.) in old people. Choroiditis in this region and elsewhere in the fundus is common in progressive myopia.

Treatment.—The constitutional causes give the indications for the medicinal measures, among which small doses of mercury take high rank, and it is said the subconjunctival injections are effectual. The eyes should be protected from strong light and prolonged ocular use should be forbidden.

SUPPURATIVE CHOROIDITIS AND IRIDO-CHOROIDITIS.—When suppuration takes place between the retina and choroid, it is characterized by intense pain, swelling of the lids, the formation of pus in the anterior chamber and vitreous, and gradual purulent involvement of all the ocular tissues (*panophthalmitis*). The eyeball shrinks, and the atrophy which ensues causes a condition which is called *phthisis bulbi*.

Causes.—These include infection entering through external wounds of the ball, septic operations, sloughing corneal ulcers, general pyæmia, especially puerperal sepsis, cerebro-spinal meningitis, small-pox, measles, dysentery, and inflammation of the umbilical veins.

Treatment.—In the early stages leeches and ice compresses, and later hot stupes, are advisable. Injections of various antiseptic substances into the vitreous have been recommended, particularly aqua chlorinata (Berry).[1] In hopeless cases the sclerotic may be incised to evacuate the pus, or the eyeball removed. The latter procedure is condemned by many surgeons lest meningitis ensue, and evisceration is preferred.

RUPTURE OF THE CHOROID.—Blows upon the eye may be followed by choroidal rupture, discoverable with the ophthalmoscope, usually in the form of a yellowish-white, sickle-shaped lesion bordered with pigment. Rest, atropine, and a pressure bandage are indicated during the early stages.

DISEASES OF THE VITREOUS.

HYALITIS is the name given to inflammation of the vitreous, which may be suppurative, and arises under the same conditions described in connection with purulent choroiditis. Sometimes pus in the vitreous resembles in appearance a glioma, and is called, very unfortunately, *pseudo-glioma*. The history of the case, the signs of iritis, and diminished tension of the globe will usually distinguish the disease from a retinal tumor.

OPACITIES IN THE VITREOUS are either fixed or moving, and are detected with the ophthalmoscope. They assume all manner of shapes, from fine, dust-like particles to large membranous curtains, and disturb the vision according to their size and destiny. Their common causes are refractive error (myopia), ocular disease (irido-cyclitis and choroiditis, often syphilitic), injuries and general diseases—*e. g.* gout, syphilis, malaria, fevers, etc.

[1] In a dog the author has checked a purulent hyalitis by injecting the vitreous with bichloride (1 : 2000).

Treatment.—This must be governed by the cause, and usually mercury, iodide of potash, and pilocarpine diaphoresis are indicated. Galvanism has been used with good effect, and the denser varieties may need surgical interference.

MUSCÆ VOLITANTES are black specks floating in the field of vision, especially if the eye is directed to a bright surface. Very annoying, and commonly attributed by the laity to a disordered liver, they are in themselves harmless, and probably represent shadows formed upon the retina by natural elements floating in the vitreous. Correction of a refractive defect frequently causes them to disappear.

When the vitreous is fluid and contains cholesterin-scales, these appear to the ophthalmoscope as a shower of brilliant crystals. The affection receives the name *synchisis scintillans*.

HEMORRHAGE INTO THE VITREOUS is a common result of a blow or may be caused by a spontaneous rupture of a ciliary, choroidal, or retinal vessel.

DISEASES OF THE RETINA.

In the brief space allotted it is impossible to do more than refer to a few of the most important diseases of this membrane.

RETINITIS.—This is the general term applied to the various primary or secondary, diffuse or circumscribed, serous, parenchymatous, or purulent inflammations of the retina.

Symptoms.—The ophthalmoscopic symptoms are loss of transparency, areas of exudation, tortuosity of the vessels, hemorrhages, congestion of the optic papilla, pigmentation, and atrophy of the retinal elements. The subjective signs are diminished visual acuity, distortion of vision, especially *micropsia*, or an apparent reduction in the size of objects, and *metamorphopsia*, or change in their shape.

Syphilitic retinitis usually appears in the form of a *retino-choroiditis*, giving rise to symptoms already detailed, in addition to which the vitreous is filled with dust-like opacities. Another form is more truly retinal in origin, the optic nerve appearing as a discolored oval in the centre of the foggy retinal tissue. Hemorrhages may also be present.

It may develop in congenital and acquired syphilis, in the latter form usually appearing from six months to two years after infection.

The usual remedies are indicated.

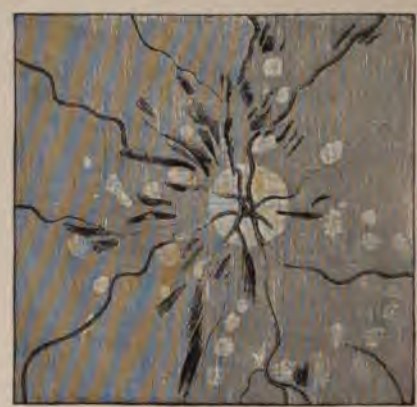
Purulent retinitis arises under conditions analogous to those which cause suppurative choroiditis, and *hemorrhagic retinitis* is the name usually given to any type of retinitis associated with hemorrhages, the most important variety being

Albuminuric Retinitis (Retinitis of Bright's disease).—The characteristic feature of this disease is the development in the retina of variously shaped and placed white and yellowish-white spots, often arranged in a star-shaped figure in the macular region (Fig. 71). They are due to fatty degeneration of the retinal elements. In addition, there are numerous hemorrhages, and usually the nerve-head is swollen and infiltrated (optic neuritis). Several types of the affection are described—inflammatory, degenerative, hemorrhagic, and neuritic.

Cause.—Retinitis may occur in any form of Bright's disease, but

is most frequent in chronic interstitial nephritis, albuminuria of pregnancy, and scarlatinal nephritis. The variety occurring during pregnancy may terminate favorably, but when retinitis is a sign of chronic nephritis

FIG. 71.



Recent severe retinitis in renal disease (Gowers).

the prognosis is most unfavorable, death being common within eighteen months after the appearance of the retinal lesion.

Diabetes and leucocythæmia also produce striking types of retinitis, and the same is true of several other affections which are associated with changes in the composition of the blood and the tissues of the blood-vessels, or with disturbances of circulation.

PIGMENTARY DEGENERATION OF THE RETINA (Retinitis pigmentosa) is a degenerative disease of the retina, associated with marked contraction of the vessels and the accumulation of pigment-masses, which assume a stellate appearance, resembling the Haversian canals. The optic nerve undergoes atrophy.

The subjective **symptoms** are great depreciation of central vision, progressive contraction of the field of vision, and night-blindness, the last symptom being the one which usually first calls attention to the disease.

The affection is either congenital or begins in early childhood, and has been attributed to consanguinity of the patient's parents and also to inherited syphilis.

The **prognosis** is bad, and **treatment** of little avail; this may consist of bichloride of mercury, strychnia, and galvanism.

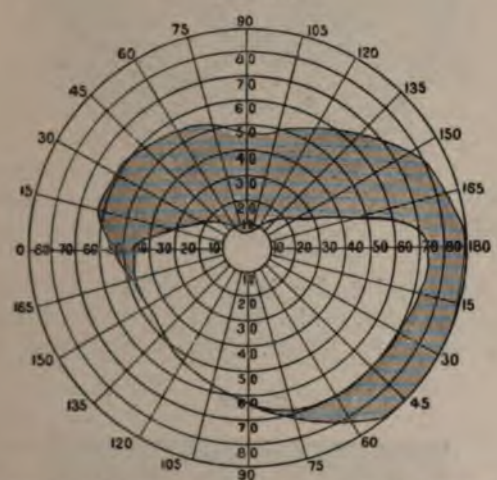
EMBOLISM OF THE CENTRAL ARTERY OF THE RETINA, which may occur with valvular disease of the heart and other vascular disturbances, produces sudden blindness and characteristic ophthalmoscopic appearances—thinning or obliteration of the retinal arteries; often an intermittent blood-stream in the veins; pallor of the papilla and fog-like œdema of the retina, with a *cherry-colored spot* in the macular region. Instead of the main trunk, a branch may be plugged with the embolus, and the obstruction be visible to the ophthalmoscope.

Thrombosis produces similar symptoms: if the central vein is obstructed, there may be the appearances of a violent hemorrhagic retinitis.

Blows upon the eye may produce several varieties of *traumatism of the retina:* (*a*) Anæsthesia; (*b*) amblyopia associated with œdema (*commotio retinæ*); (*c*) rupture of the retina; and (*d*) detachment of the retina.

DETACHMENT OF THE RETINA.—In addition to traumatic detachment there is idiopathic separation of the retina from the underlying choroid, due to an accumulation of serum between the membranes. The elevation is visible with the ophthalmoscope, and may often be seen to float forward in the vitreous in the form of a gray veil, while, corresponding to the seat and extent of the detachment (central or peripheral, partial or complete), there are disturbance of vision and obliteration of the visual field (Fig. 72).

FIG. 72.



Visual field in detachment of the retina, from a patient in the Philadelphia Hospital.

Traumatisms, disease of the vitreous, choroid, etc., intraocular growths and progressive myopia, are the usual causes.

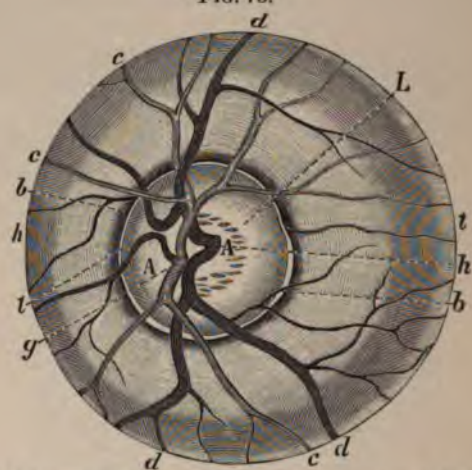
Treatment.—Rest in a recumbent posture, a compressing bandage, pilocarpine diaphoresis, or diuresis with salicylic acid may be tried; if these fail and the subretinal fluid is serous, scleral puncture is advisable. Numerous other surgical procedures (sclerotomy, iridectomy, galvanopuncture, injection of iodine, etc.) have been proposed, but are of more than doubtful value.

DISEASES OF THE OPTIC NERVE.

NORMAL FUNDUS OCULI.—In order to obtain an adequate idea of the most important lesions visible in the nerve-head the normal appearance represented in Fig. 73 should be understood. The optic disk is nearly round or slightly oval, varies in color from a grayish-pink to a decided red, and contains near its centre a white patch ("light spot"), which may be a distinct depression or cup (physiological cup). From this

spot the principal retinal arteries emerge, and into it the chief venous trunks empty. The veins are larger (in the proportion of three to two) and darker than the arteries. The general color of the fundus is a uni-

FIG. 73.



The entrance of the optic nerve, with the adjacent parts of the fundus of the normal eye: *A*, physiological excavation; *b*, choroidal ring; *c*, arteries; *d*, veins; *g*, division of the central artery; *h*, division of the central vein; *L*, lamina cribrosa; *t*, temporal (outer) side; *n*, nasal (inner) side.

form red. In the central region is an area uncrossed by large vessels, which is the macula lutea, containing in its centre the bright spot, or *fovea centralis*. It is the portion of retina concerned with the func-

FIG. 74.

Ophthalmoscopic appearance of severe recent papillitis; several elongated patches of blood near border of disk (after Hughlings Jackson).

tions of direct vision. The retina is practically transparent, and the red color arises from the underlying choroid.

OPTIC NEURITIS.—Von Graefe distinguished two forms—*descending*

neuritis and *choked disk* (Stauung's papille), but as these terms refer to distinctions in the pathology of the affection which are not definitely settled, the general name *papillitis*, suggested by Leber, is useful.

The nerve-head is at first swollen and congested, the veins dark and tortuous, and, as the congestion increases, the optic papilla is utterly obscured, and, as it were, replaced with a grayish-red, mound-like swelling, within which the arteries, usually small in size, are partly hidden. The infiltration may terminate near the disk or spread into the surrounding retina; hemorrhages on the swelling and in the neighborhood are common (Fig. 74). Often vision is disturbed, but it may be entirely normal, even with high grades of optic neuritis. Gradually, if recovery takes place, the infiltration and swelling subside, the margins of the disk reappear, and the nerve-head itself, usually pallid and with its centre filled in, becomes apparent. If the elements have been too long inflamed or pressed upon, atrophy of the optic nerve ensues—post-papillitic atrophy.

Causes.—Intraocular optic neuritis is caused by brain-tumor,[1] especially that variety in which the signs of mechanical congestion are most marked ("choked disk"); by various types of meningitis, particularly when they attack the base of the brain; by abscess, cerebritis, hemorrhage (rarely), hæmatoma of the dura, thromboses of the cavernous sinuses, hydrocephalus, and aneurysm. Non-intracranial causes are—acute febrile affections, syphilis, toxic agents—*e. g.* lead—anæmia, menstrual derangement, rheumatism, orbital diseases and affections of the antrum, frontal sinus, ethmoid, and sphenoid bone, and injuries. One variety is associated with dropping of a watery fluid from the nose.

Mechanism.—There are many theories to explain the mechanism of papillitis. It is probable, according to Gowers, that in most cases an inflammation may be traced from the cerebral lesion to the intraocular end of the nerve, and that to this may be added the signs of mechanical congestion or swelling of the disk from deposition of inflammatory products within the inflamed nerve-head; and, finally, that the intensity of the process may be increased by distention of the nerve-sheath, perhaps with cerebro-spinal fluid possessing an irritative quality.

Treatment.—This depends upon the cause, and with this indication in view includes mercury, iodide of potassium, pilocarpine, iron, and salicylic acid. Surgical measures to relieve frontal-sinus disease and allied causes may be needed; it has been suggested to expose the swollen nerve-sheath, slit it, and evacuate the contained fluid.

ATROPHY OF THE OPTIC NERVE.—This may be *primary*, *secondary*, or *consecutive*, or may be caused by retinal and choroidal disease.

Symptoms.—With the opthalmoscope the following appearances are usually visible: Alteration of the normal color of the disk to a slight gray, a pure gray, greenish-gray, or entirely white hue, according to the variety of the disease and stage of the disorder; atrophic depression, or excavation of the centre of the nerve-head, the margins of which are unusually distinct; and alteration in the size of the vessels, which (especially the arteries) are much contracted and often encased between lines

[1] Fully 80 per cent. of the intracranial tumors at one time or another of their existence are associated with optic neuritis (Gowers). The author believes that this percentage is none too high, and that with careful examination it would rise higher.

of white tissue due to thickening of the perivascular lymph-sheath. In many cases of primary atrophy the vessels are not much altered in size, while in retinitic atrophy their contraction may be extreme. Other symptoms are—failure of central vision, contraction of the field of vision, defective color-sense going on to complete color-blindness, and diminished activity of the direct pupillary reflex.

Primary atrophy is associated with locomotor ataxia, paretic dementia, insular sclerosis, lateral sclerosis, and may also be due to syphilis, exposure to cold, chronic malaria, diabetes, and menstrual disorders.

Secondary atrophy is caused by pressure upon the optic tract or optic fibres—*e. g.* by a tumor, exostosis, etc. It may follow blows upon the head.

Consecutive atrophy is caused by an antecedent neuritis, and in the retinitic and choroiditic forms by diseases of the retina and choroid.

Treatment.—Depending upon the cause, the medicinal treatment of optic-nerve atrophy includes strychnia in very full doses, preferably by hypodermic injection; nitro-glycerin; phosphorus and its compounds; the alteratives, especially small doses of mercury and iodide of potassium; nitrate of silver; and, according to Valude, antipyrine, given subcutaneously. Many other remedies have been tried without notable success, even injections of organic fluids, after the manner of the late Brown-Séquard. Although electricity, administered particularly, as recently suggested, in the form of voltaic alternatives, has many advocates, the author confesses to great disappointment in its use in his own practice. Suspension has been credited with a few improvements, but the prognosis of optic-nerve atrophy, when of the progressive type, is exceedingly unfavorable under any therapeutic regimen. There is no good evidence to show that stretching of the optic nerve is a justifiable operation.

Orbital optic neuritis is the name given to an inflammation in the orbital part of the optic nerve, and therefore is frequently called *retrobulbar neuritis*. It appears both in an acute and chronic type. In the former there may be moderate retinal congestion and some blurring of the margins of the disk, with great impairment of sight, particularly in the form of a large darkened area in the centre of the field of vision—namely, a *central scotoma*. The affection may be caused by toxic agents—*e. g.* alcohol, lead, etc.; menstrual disturbances, rheumatism, the exanthemata, influenza, and other conditions not well understood.

The chronic type of the affection is frequently called *tobacco amblyopia*, *toxic amblyopia*, or *amblyopia potatorum*. Its most common cause is abuse of alcohol and tobacco, and there is little doubt that of these two agents tobacco is the more potent, although they are usually combined. Sometimes there is no ophthalmoscopic sign of its presence; later there is a quadrant-shaped atrophy in the lower and outer part of the disk.

The chief **symptom** of the disease is the diminution of color-perception and the formation of a color-scotoma, especially for red and green, in an oval area situated midway between the point of fixation and the normal blind spot.

It is a rare disease before the thirty-fifth year, and the **prognosis** is perfectly good, provided the patient will cease the use of tobacco and alcohol.

Strychnine, iodide of potassium, and nitro-glycerin improve the chances of recovery.

Disturbances of Vision without Ophthalmoscopic Changes.

Amblyopia and Amaurosis.—These terms both signify dimness of vision, the former being used to describe obscurity of sight, and the latter the more advanced condition of loss of vision. Improved methods of examination have diminished the number of cases to which these terms are applicable, but they are still used to designate certain types of disease due to functional disturbance or disease of the visual apparatus unassociated with changes in the eye-ground, They are also applied to cases of atrophy of the optic nerve. Amblyopia may be *congenital*, *acquired*, *temporary*, or *permanent*, and affect one or both eyes.

Congenital amblyopia is the name given to faulty vision which has always existed, usually associated with high grades of hypermetropia and astigmatism, the defective vision sometimes being attributed to lack of use, as, for example, in a squinting eye (*amblyopia ex anopsia*).

Color-blindness, or congenital amblyopia for colors, is present in about 5 per cent. of the examinations made for this purpose among men. It is uncommon in women. There are two types, one being characterized by lack of power to perceive colors (*achromatopsia*), and the other by difficulty in distinguishing colors (*dyschromatopsia*). The most usual manifestation is red-green blindness. Blue-yellow blindness is also described, but is uncommon.

Examinations for color-blindness are of the utmost importance in railway services, steamship lines, and the merchant marine, and numerous methods have been devised for detecting these defects, most of which are modifications of the so-called Holmgren method, in which the candidate is required to match a test skein of Berlin wool—for example, a green or rose-red—with other color skeins cast in a heap upon the table. In the railway service it is sometimes advisable to test at great distances. Specially-devised lanterns have been constructed for this purpose.[1]

Other forms of amblyopia are *reflex amblyopia*, attributed to irritations in distant portions of the body; *traumatic amblyopia*—for example, after severe injuries to the head, particularly in the occipital region; *uræmic amblyopia*, most common in scarlet fever and pregnancy; *glycosuric amblyopia*, or that variety seen in saccharine diabetes; *malarial amblyopia*; *amblyopia from the loss of blood*; and *amblyopia from the abuse of drugs*. One form of the last-named amblyopia has already been referred to—namely, the so-called tobacco amblyopia. Analogous symptoms may arise under the influence of poisonous doses of bisulphide of carbon, nitrobenzol, iodoform, salicylic acid, lead, and probably silver and mercury.

A most remarkable amaurosis is produced by toxic doses of quinine

[1] This very important subject can only receive this brief notice, but physicians should be acquainted with the ordinary tests for color-blindness, as they may at any time be called upon to decide the acceptability of a candidate for position in a service where the prompt recognition of colors is of paramount importance. Perhaps the most generally useful directions are those given by Dr. William Thomson in his chapter on "The Examination for Color-perception" in Mr. Nettleship's *Diseases of the Eye*, 4th Am. ed., p. 461.

characterized by extreme pallor of the disk and contraction of the retinal vessels. In experimental quinine blindness absolute optic-nerve atrophy may ensue.[1]

Hysterical amblyopia, often monocular and frequently associated with subnormal color-perception and peculiar changes in the visual field, is a very interesting phenomenon not infrequently observed as one of many other hysterical stigmata, and difficult to distinguish from a *pretended amblyopia* or malingering. The latter condition may be detected by placing before the patient's eye a prism, and thus causing him to see double. Acknowledgment of the double images means that the patient sees with the eye declared to be blind.

NIGHT-BLINDNESS (Nyctalopia).—This may be a symptom of pigmentary degeneration of the retina, but occurs as a functional disturbance without ophthalmoscopic changes after exposure to strong light in debilitated subjects, and is said to be endemic in certain countries, especially Russia.

DAY-BLINDNESS (Hemeralopia), or the ability to see better on dull days and in the dark than in a bright light, has been noted with orbital optic neuritis, with certain congenital anomalies of the eye, and as an idiopathic affection in those who have long been excluded from the light.

SNOW-BLINDNESS is usually an affection of the conjunctiva, a species of erythema, produced by the heat reflected from the surface of the snow. Restriction of the field of vision, scotoma, and night-blindness may be caused by the same conditions.

ERYTHROPSIA, or red vision, is a remarkable phenomenon occasionally seen after cataract extraction.

SCOTOMAS, or blind areas in the field of vision, are caused, as already stated, by retrobulbar neuritis, and also by a number of other conditions associated with changes in the optic nerve and perhaps also in the visual centres. These scotomas may be central, paracentral, or peripheral, and they may assume various shapes, usually oval or round, but sometimes crescentic or annular. They are divided into *positive* and *negative* scotomas, the former being appreciated by the patient and the latter unnoted by him. They are detected by making an examination with small test-objects, white or colored, moved in different directions from the point which the eye under observation attentively fixes; for example, the centre of a perimeter or of a black board.

HEMIANOPSIA.—This is an obscuration of one-half of the visual field, usually in each eye, which occurs under the influence of a lesion situated in the optic chiasm, in the visual tract, or in the visual centres in the occipital lobe.

If the chiasm is affected, the hemianopsia is *crossed* or *bitemporal*—*i. e.* both temporal fields are wanting. If one optic tract is pressed upon, or if there is an interruption in the visual pathway, or a lesion in the cuneus, the hemianopsia is *homonymous*, the corresponding half of each visual field being wanting—*right homonymous lateral hemianopsia* if the right half of each field is dark, and *left homonymous lateral hemianopsia* if the left half of each field is dark. The relation of the pupillary reflexes to hemianopsia and to the localization of the

[1] See the author's researches, *Trans. Amer. Ophthalmolog. Soc.*, 1891.

lesion which has produced the visual defect, has been described on page 258.[1]

Movements of the Eyeballs, and their Anomalies.

Paralysis or paresis of any one of the nerves concerned in the supply of an ocular muscle produces the condition to which, in general terms, the name *paralytic strabismus* is applicable. This should be distinguished from the other type of squint, known as concomitant squint or strabismus. (See p. 312.)

Symptoms of Paralysis of an External Ocular Muscle.—There are certain general symptoms more or less common to paralysis of the external eye-muscles—namely, diplopia, or double vision; strabismus, or deviation of the affected eye; limitation of movement in the direction of the action of the diseased muscle; inaccurate estimation of the position of objects situated in such a portion of the visual field that it requires an effort on the part of the affected muscle to turn the eye toward them; vertigo; and an altered position of the carriage of the head, the face usually being turned in the direction toward which the affected muscle moves the eye.

There are two kinds of diplopia—*simple* or *homonymous* if the right image pertains to the right eye and the left image to the left eye; *crossed* or *heterononymous* if the right image pertains to the left eye and the left image to the right eye.

Paralysis of the Abducens or Sixth Nerve, thus affecting the external rectus, causes homonymous diplopia, the images being side by side, convergent strabismus, and limitation of movement in the direction of the action of the affected muscle.

Paralysis of the Fourth or Trochlear Nerve, thus affecting the superior oblique muscle, causes homonymous diplopia in the lower field, the images being one above the other, the image of the affected eye being lower than its fellow and inclined to the sound side, and deviation of the affected eye upward and inward.

Paralysis of the Oculo-motor Nerve, thus affecting the internal, superior, and inferior recti muscles and the inferior oblique, as well as the levator palpebræ, produces crossed diplopia, divergent strabismus, limitation of movement of the eye in all directions except outward and slightly downward, ptosis, and dilatation of the pupil.

Frequently, however, the paralysis is limited to certain branches of the nerves:

(*a*) The nerve-supply of the internal rectus, which causes crossed diplopia, the images being side by side; divergent strabismus; and limitation of movement in the direction of the action of the affected muscle.

(*b*) The nerve-supply of the superior rectus, which causes crossed diplopia in the upper field, the images being one above the other, the image of the affected eye being higher than its fellow and inclined to the healthy side; downward strabismus; and limitation of movement in the upward direction.

[1] Those desiring to study the significance of hemianopsia, in so far as the localization of intracranial lesions are concerned, are referred to Swanzy's Bowman lecture, *Trans. of the Ophth. Soc. of the U. K.*, vol. ix., 1889; Seguin, *Journ. of Nervous and Mental Disease*, 1886 and 1887; and Noyes, *N. Y. Medical Record*, April 4, 1897.

(*c*) The nerve-supply of the inferior oblique, which causes homonymous diplopia in the upper field, the images being one above the other, the image of the affected eye being higher than its fellow and inclined to the affected side; deviation of the affected eye downward and inward; and limitation of movement upward and outward.

(*d*) The nerve-supply of the inferior rectus, which causes crossed diplopia in the lower field, the images being one above the other, the image of the affected eye being lower than its fellow and inclined to the affected side; upward strabismus; and limitation of movement in the downward direction.[1]

Causes.—Paralysis of an ocular muscle may be caused by a central or peripheral lesion. The following are the most usual causes: Syphilis, rheumatism, diphtheria, diabetes; various poisons—*e. g.* lead, gelsemium, chloral, alcohol, etc.; disease at the base of the brain—*e. g.* meningitis; diseases of the cerebro-spinal axis, particularly locomotor ataxia; injuries; and congenital faults.

Treatment.—This depends entirely upon the cause, and when it is syphilitic or rheumatic the prognosis is good, the usual remedies pushed to their point of tolerance being effective. The annoyance of the double images may be avoided by placing a shade or a piece of ground glass over the affected eye. In the later stages mechanical treatment has been suggested by Michel, and electricity is sometimes of service. If other means fail, tenotomy of the antagonist or advancement of the paralyzed muscle may be necessary.

OPHTHALMOPLEGIA.—This term, although applicable to paralysis of all of the muscles of the eye, is particularly reserved for that class

FIG. 75.

Ophthalmoplegia externa, from a patient under the care of Dr. Griffith in the Children's Hospital.

due to disease of the nuclei of the third, fourth, and sixth nerves; hence *nuclear paralysis*. It may be *acute* or *chronic*, and when, as sometimes

[1] Only the most striking symptoms have been detailed. If there is paresis and not paralysis, which is the more common condition, a diagnosis of the affected eye can only

happens, the intraocular muscles alone are affected, the term *ophthalmoplegia interna* is utilized, although the old division, originally proposed by Mr. Hutchinson, into *external* and *internal ophthalmoplegia*, is not now retained, because the two sets of muscles may be affected in the same case.

These cases of ophthalmoplegia are due to a variety of affections, degenerative, inflammatory, or hemorrhagic, located in the region of the nuclei or the nuclear fibres. They occur under the influence of several diseases and toxæmias; for example, locomotor ataxia, paralytic dementia, progressive muscular atrophy, and chronic bulbar paralysis.

The **symptoms** are practically those of complete fixation of the eyeball and ptosis. Syphilitic cases will often do well under the usual treatment. In many other types the condition is practically incurable (Fig. 75).

NYSTAGMUS is a rapid alternating movement of the eyeballs, the oscillations usually being in the lateral direction; occasionally they are rotary and sometimes up and down. One of the most striking types of nystagmus occurs in miners, and has been particularly studied by Mr. Simeon Snell of Sheffield, who has shown that it is due to working by the aid of a dim light and keeping the eyes in an unusual position for many hours together. In many instances nystagmus is congenital. It is practically always present in albinos, and is exceedingly common in diseases of the nervous system, particularly disseminated sclerosis, Friedreich's ataxia, and tumors of the cerebellum.

DISEASES OF THE LACHRYMAL APPARATUS.

DACRYO-ADENITIS.—Inflammation of the lachrymal gland is rare, but may be found in an acute or chronic, suppurative (abscess) or non-suppurative form. If there is pus, an incision either through the integument parallel to the eyebrow or through the conjunctiva will evacuate the purulent matter. If it is pure induration, the swelling may be treated with iodine or iodide-of-cadmium ointment.

DACRYOPS is a cystic distention of one of the lachrymal gland-ducts, and causes a bluish translucent swelling beneath the conjunctiva at its upper and outer part.

EPIPHORA, or an overflow of tears, sometimes called *stillicidium lachrymarum*, is the symptom which commonly calls attention to obstruction in the lachrymo-nasal passages which may exist in the puncta lachrymalia, in the canaliculi, in the sac, or in the lachrymo-nasal duct.

Anomalies of the puncta lachrymalia include congenital malformation or closure and obstructions caused by chronic inflammations of the lid and conjunctiva, foreign bodies, a mass of fungus, or a polyp-formation. The inflammations of the lachrymal sac are included under the general term—

be made by carefully studying the position of the double images. For the rules which govern such examinations the reader is referred to systematic treatises on ophthalmology; but it may be stated, in general terms—(1) That image is false, and consequently belongs to the affected eye, which in the region of double vision moves faster than a moving test-object—*e. g.* a candle-flame. (2) In pathological convergence homonymous diplopia appears; in pathological divergence heteromonymous or crossed diplopia (with homonymous diplopia, closure of an eye causes disappearance of the image on that side; with crossed diplopia the image on the opposite side). (3) The relation of the double images to each other is so arranged that the false image or image of the affected eye is projected in the direction toward which the paralyzed muscle normally rotates the eye.

DACRYO-CYSTITIS, in which there is a catarrhal or purulent inflammation of the lining membrane of the lachrymal sac. It usually manifests itself by a moderate distention over the region of the lachrymal sac (*mucocele* or *lachrymal tumor*), and pressure upon this expresses through the puncta the retained fluid, either mucoid or purulent according to circumstances. If the inflammation is very acute, the condition called *lachrymal abscess* results, the pus frequently burrowing externally and opening on the face below the tendo oculi.

A purulent inflammation of the lachrymal sac always means that there is organic *stricture of the duct* below, and this usually antedates the dacryo-cystitis, the obstruction selecting by preference the point at which the nasal duct enters into the sac. Instead of stricture there may be closure from swelling of the mucous lining.

The most usual **causes** of disease of the lachrymal sac and nasal duct are morbid conditions of the nasal chambers and rhinopharynx, periostitis of the lachrymal bone, often syphilitic, traumatism, pressure from neighboring cavities, foreign bodies, and occasionally the exanthemata, chiefly because they produce inflammation of the nasal mucous membrane.

Treatment.—It is advisable to attempt the cure of disease of the lachrymo-nasal apparatus without surgical interference by irrigation of the area with antiseptic fluids and by the treatment of the cause, which should always be ascertained, particularly when this resides in the rhinopharynx. In organic stricture three procedures are usually necessary: slitting the canaliculus, introducing the probe into the nasal duct, and syringing the sac and naso-lachrymal passage. The dilatation of a duct may be either rapid or gradual. Many probes are useful, those commonly employed being the Bowman or the Williams probe. A lachrymal abscess is treated on the same principles as those which govern pus-formation in other structures. Occasionally it is necessary to introduce a permanent style, usually made of lead wire. The important relation of the secretions from a diseased lachrymo-nasal duct to corneal lesions has been explained. Dacryo-cystitis is a distinct contraindication to operative interference; for example, cataract extraction. (Operations in the lachrymal apparatus are fully described in the article on the Surgery of the Eye.)

NORMAL AND ABNORMAL REFRACTION OF THE EYE.

1. IMPAIRMENT OF VISION.—In order to ascertain the acuteness of vision, which is the power of distinguishing form and size, test-types are employed, and the patient should be placed six metres, or twenty feet, from the test-card in a well-lighted room and each eye tried separately. If the letters of No. 6 (twenty feet, approximately) are read, vision is normal, or 1, and the record 6/6 or 20/xx is made; but if at the same distance no smaller letters than those numbered 12 (forty feet) can be discerned, vision is 1/2, and the record 6/12 or 20/xl is made.

Acuity of vision may be impaired—(*a*) by congenital malformation of the eye; (*b*) by anomalies of refraction—*e. g.* myopia, astigmatism, etc.; (*c*) by disease or lesion of the transparent media—*e. g.* corneal scars, cataract, etc.; (*d*) by disease or lesion which interferes with the functions

of the deeper structures of the eye—*e. g.* retinitis, atrophy of the optic nerve; (*c*) by disease of the visual centres in the brain.

The Ophthalmoscope.—The interior of the eye is examined with the ophthalmoscope, an instrument composed essentially of a mirror with which to throw light into the interior of the eye, and a circular aperture in the mirror through which the surgeon examines the illuminated part of the retina. The mirror is usually concave, so as to concentrate the light in the pupil. The ophthalmoscope was invented by Helmholtz in 1851, and revolutionized the study of ophthalmology. The modern instrument is usually arranged with numerous lenses, by means of which the refractive conditions may be studied, and is called a *refraction ophthalmoscope*. Many models are excellent; in the author's opinion the one designed by the late Dr. Loring answers every purpose.

There are two methods of using the ophthalmoscope, the *direct* and the *indirect* method. By the direct method a magnified (about 15 diameters) image of the various parts of the fundus in their natural positions is obtained. The patient is seated in a darkened room with his back to the source of illumination, and the surgeon at the side which corresponds to the eye under observation. Looking through the sight-hole of the instrument, which is approximated closely to his eye—for example, the right one—and held at a distance of about fifty centimetres from the observed eye, and keeping the light steadily in the pupillary

FIG. 76.

Use of the ophthalmoscope (Loring).

space, the observer approaches the eye of the patient as closely as possible, within one inch or even nearer (Fig. 76).

By the indirect method an inverted, less highly magnified aërial image of the fundus is obtained. The surgeon and patient are seated in

the same relative positions as previously described, and the ophthalmoscope is held, for example, in the right hand at a distance of thirty centimetres from the patient, who is instructed to look at the right ear of the examiner. A strong convex lens is now placed at about its own focal length from the patient's eye directly in the path of the rays returning from the fundus, which are thus brought to a focus and form an image between the observer and the glass.

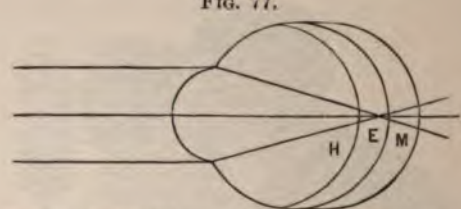
EMMETROPIA.—This is the standard optical state of the eye when its retina is just far enough back of the cornea and crystalline lens to have parallel rays brought to a focus upon it without an effort of accommodation. It is represented by the letter E. (Vide E, Fig. 77.)

AMETROPIA is the opposite of emmetropia, and the general term which describes the anomalous refractive conditions which follow.

HYPERMETROPIA (Hyperopia) is the state of refraction of an eye when its retina is too near the cornea and lens, and parallel rays fall upon it before they are focused, the accommodation being at rest; that is to say, they are focused behind the retina. It is represented by the letter H, and the condition is often called far-sightedness. (Vide H, Fig. 77.)

MYOPIA is the state of refraction of an eye when its retina is too far back of the cornea and lens, so that parallel rays are focused before they reach it. It is represented by the abbreviation M, and is often called near-sightedness. (Vide M, Fig. 77.)

FIG. 77.



The position of retina in hypermetropia, emmetropia, and myopia.

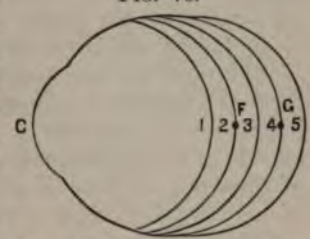
ASTIGMATISM.—This term describes a defect of the eye, usually caused by different refractive power of the chief meridians, which prevents the formation of a distinct retinal image of an object in all its parts. A luminous point, for example, forms an image on the retina of such an eye the shape of which is a line, an oval, or a circle, but never a point.

Astigmatism is regular or irregular. In regular astigmatism one principal meridian may be emmetropic and the other ametropic (simple astigmatism), or both principal meridians may be ametropic, but of the same character of refraction (compound astigmatism); or one principal meridian may be hypermetropic and the other myopic (mixed astigmatism). Irregular astigmatism consists in a difference of curvature in the different parts of the same meridian. Astigmatism usually has its seat in the cornea, but may also be lenticular (Fig. 78).

Symptoms of Ametropia.—In addition to imperfect vision, ametropia, especially hypermetropia or astigmatism, may cause hyperæmia of the conjunctiva, inflammations of the margins of the lids, congestions

of the deeper coats of the eye, and particularly headache. Numerous nervous phenomena owe their origin to the same source; for example, migraine, habit chorea, insomnia, general nervousness, etc. Ametropic eyes should always be fitted with suitable glasses, determined, in patients under the forty-fifth year of age, after the pupils have been dilated with a suitable mydriatic, preferably atropine. Hypermetropia is corrected with a convex lens, myopia with a concave lens, and astigmatism with a cylindrical lens.

FIG. 78.



The different varieties of astigmatism: C represents the position of an astigmatic cornea, and F and G, the positions of the two focal lines, 1, 2, 3, 4, and 5, different positions in which the retina may be situated. When the retina is at 1, with both the foci behind it, the error of refraction is called compound hyperopic astigmatism. When the retina is at 2, one focus on the retina and the other behind it, it is called simple hyperopic astigmatism. When the retina, as at 3, lies between the two foci, it is called mixed astigmatism. When the retina is at 4, one focus on it and the other in front of it, it is simple myopic astigmatism. When the retina is at 5 with both of the foci in front of it, the case is one of compound myopic astigmatism (after Edward Jackson).

The degree of astigmatism in a cornea may be approximately measured with an ophthalmometer, preferably with the model named after Javal. A delicate test of the refractive condition of the eye is known as *skiascopy* or *the shadow test* (*retinoscopy*).

The lenses which are utilized to correct anomalies of refraction at the present time are numbered by the *dioptric* system, that lens which brings parallel rays to a focus at a distance of one metre is the unit and is called a one-dioptre lens, written 1 D. A lens twice as strong is called a two-dioptre lens, etc. Formerly the lenses were numbered by the inch system.

ACCOMMODATION.—This is the term which describes the changes in the optical adjustment of the eye effected by the ciliary muscle, and in practice is measured by finding the nearest point at which fine print can be clearly deciphered. The power of accommodation gradually diminishes from early life onward, and is practically obliterated by the sixty-fifth year.

PRESBYOPIA is the normal result of growing old, and is the term which describes the decrease of the power of accommodation to such an extent that it interferes with the ordinary use of the eyes for purposes of close vision; for example, writing, reading, etc. It is corrected by placing before the eye a convex glass, which restores the near-point of vision to a comfortable situation. Presbyopia usually begins between the fortieth and fiftieth years. Hypermetropia increases the necessity for the early use of convex lenses, while myopia has the opposite effect, myopes of a certain degree never becoming presbyopic.

APHAKIA is the name given to the state of refraction caused by absence of the crystalline lens—for example, after cataract extraction. It is equivalent to H of about 11 D.

ASTHENOPIA, or weak sight, is a general term used to describe the inconveniences which arise on account of various refractive and muscular defects in the ocular apparatus. It may depend upon insufficient power of accommodation in cases of hypermetropia and astigmatism (accommodative asthenopia), upon an abnormal balance of the external ocular muscles (muscular asthenopia), or upon a neurotic condition (neurasthenic asthenopia).

INSUFFICIENCY OF THE OCULAR MUSCLES—or *Heterophoria*, as it is now termed—is a fruitful source of asthenopic symptoms, and, like astigmatism and hypermetropia, may cause headache and all manner of functional nervous disturbances. It is corrected by prismatic glasses, by developing the power of the ocular muscles through gymnastic exercises, and by tenotomy or advancement.

MYDRIATICS are drugs used in ophthalmic practice, in addition to their application in the treatment of diseases of the eye—for example, iritis—for the purpose of dilating the pupil and paralyzing the ciliary muscle in the determination of errors of refraction. The most important of these are sulphate of atropine (four grains to the ounce), hydrobromate of homatropine (eight grains to the ounce, sometimes as high as sixteen grains to the ounce), sulphate of hyoscyamine (two grains to the ounce), sulphate of duboisia (two grains to the ounce), and hydrochlorate of scopolamine (two grains to the ounce). Hyoscine and daturine are also, though less frequently, used.

Hydrochlorate of cocaine (2 to 4 per cent.) may be employed as a mydriatic for the purpose of dilating the pupil as an aid to ophthalmoscopic examination, but is of no value to paralyze the power of accommodation. It is almost exclusively used to produce local anæsthesia. A new mydriatic is ephedrin-homatropin. It dilates the pupil, but does not paralyze the accommodation.

OPERATIVE SURGERY OF THE EYE.

By HENRY D. NOYES, M. D., and JOHN E. WEEKS, M. D.

In operating on the eye and its appendages the strict observance of asepsis and antisepsis is essential to success. The advice given in the article on "The Technique of Antiseptic and Aseptic Surgery" applies with equal force to the surgery of the eye. The integument should be cleansed with soap and water, this to be followed by careful washing with a solution of the bichloride of mercury, 1 : 2000. If the operator should not be ready to proceed with the operation immediately after the cleansing process is completed, the parts should be protected by being covered with absorbent gauze or with cotton moistened in the sublimate solution.

Eyelids.

The congenital defects of the lids requiring operative procedure are *colobomata*, *epicanthus*, *ptosis*, *sebaceous cysts*, and *nævi*.

Coloboma of the lid consists of a triangular defect, the base of the triangle being at the margin of the lid. The defect occurs in the upper lid, and is often accompanied by dermoid tumor of the cornea.

Operation.—Usually it is sufficient to freshen the edges of the defect and bring them together with silk sutures. A hare-lip needle with the figure-of-8 suture is sometimes employed when the strain on the ordinary silk suture is considerable.

Epicanthus is a condition characterized by the presence of crescentic folds of skin which project from the bridge of the nose and conceal the inner canthi. The folds, which are symmetrical, expand as they reach the brows, producing the peculiar almond-shaped eye. The bridge of the nose appears to be abnormally broad. The condition is the rule with the Mongolian race.

Operation.—An elliptical piece of skin, the amount of which may be determined by pinching it up in the horizontal direction, may be excised and the edges brought together with sutures, or the lateral folds themselves may be excised. A collodion and cotton dressing is sufficient.[1]

Ptosis is the name given to drooping of the upper lids from whatever cause, and, except in certain acquired cases, requires operative interference when the upper lid cannot be sufficiently raised to admit of easy vision.

In cases of acquired ptosis other measures should be employed before resorting to operative treatment.

Operative Treatment.—The operation is usually the same whether

[1] Not infrequently there is also defect in the levator palpebræ, and sometimes also in the rectus superior.

the ptosis is congenital or acquired. Von Graefe's method is suitable for mild cases. It consists in an incision, 5 mm. from the margin of the lid and parallel to it, throughout the whole extent of the lid. If the skin is abundant, an elliptical piece is excised. A broad ribbon of the fibres of the orbicularis muscle is then excised, and the lips of the wound brought together by sutures which include the integument and the edges of the muscle at the borders of the wound. If the skin is not abundant, perhaps none will be removed or only a narrow strip be sacrificed: on this point one must be careful.

It has long been observed that contraction of the anterior belly of the occipito-frontalis muscle aids greatly in widening the palpebral fissure, and attempts have been made to correct ptosis by connecting the tarsal portion of the lid to this part of the occipito-frontalis muscle.

Pagenstecher's suture is intended to establish a number of cicatricial bands between the parts mentioned. One needle of a double-armed suture is passed downward through the tissue of the lid, entering at the upper margin of the brow and emerging near the free margin of the lid. The second needle is passed downward parallel to the first and about 5 mm. from it, emerging at the same level. The ends of the suture are tied over a roll of plaster, and allowed to remain until suppuration has been established along the canals in which the threads lie. One or more sutures may be employed.

A modification of the above procedure is to pass a suture from the upper margin of the brow downward through the subcutaneous tissue to the margin of the lid; then subcutaneously along the margin of the lid for 4 or 5 mm.; then parallel to the suture from above, emerging at a point opposite the point of entrance. The course is wholly subcutaneous. It is now tied over a roll, and tightened from day to day until it has cut through the intervening tissue. This serves to form a cicatricial band connecting the margin of the lid to the occipito-frontalis muscle. One or more sutures may be employed. The reaction is slight.

Chalazion.—Non-suppurative inflammation of an acinus of a Meibomian gland not infrequently produces small, hard cystoid tumors in the lids which are known as chalazia. These tumors are fixed in the tarsus, the skin being freely movable over them. On everting the lid the tarsal conjunctiva is usually found congested where it covers the tumor. The size is about that of a pea, more or less; it may be elongated or round.

Operation.—If the chalazion appears to be near the conjunctival surface, it may be opened from the inside by a free incision parallel to the margin of the lid, and the pultaceous contents removed by a sharp curette. If the inner surface of the sac is now treated with a strong solution of the nitrate of silver, the whole will heal with perfect occlusion. Excision of the entire sac from the cutaneous surface and closure of the wound by means of one or more sutures are also practised.

Xanthelasma.—Dingy, yellowish-white, slightly raised plaques which appear in the skin of the lids, usually at the inner canthi, in individuals of advanced years. Upper and lower lids are affected with equal frequency. The patches are usually symmetrical in their occurrence. The operative treatment consists in excising the piece of skin containing the plaque and bringing the edges of the wound together with sutures. They are not malignant, but will sometimes reappear.

Lagophthalmus.—The term indicates an inability to completely close the palpebral fissure. As a result of exposure, the cornea suffers either by the development of ulcers or by taking on an epidermoid condition. Shortening of the lids from any cause may produce lagophthalmus. Paralysis of the orbicularis palpebrarum muscle is a frequent cause.

OPERATION.—Tarsorraphy is an operation designed to lessen the size of the palpebral fissure. It may be performed at the outer or inner angle of the lids, as desired.

A very simple method is to pare away the free borders of the upper and lower lids to the desired extent and carefully include the angle of the commissure. In doing it, hold the lid by fixation forceps or between the thumb and finger, transfix the lid border obliquely with a Beer's cataract knife and carefully shave off a strip, leaving the cilia unmolested. The strip removed borders upon the conjunctiva on one side and grazes the roots of the cilia on the other. The raw surfaces are brought together by fine sutures. At the nasal side it is necessary to prepare a raw surface in the integument above and below the canaliculi, or to make little quadrangular flaps whose raw surfaces shall be opposed and stitched to each other. This proceeding is seldom required.

Median Tarsorraphy.—A narrow strip of skin extending from one punctum lachrymalis to the other, around the inner canthus, bordering the mucous membrane, is removed and the fresh surfaces brought together by means of sutures. In performing tarsorraphy the sutures should be permitted to remain for five or ten days, or until the surfaces have thoroughly united.

Ankyloblepharon.—Adhesion of the ciliary margins of the lids to each other. The operative procedure for the relief of ankyloblepharon consists in dividing the adhesions by a simple incision.

Symblepharon.—Adhesion of the palpebral conjunctiva to the bulbar conjunctiva or to the cornea. It is usually caused by burns or traumatism.

Symblepharon is designated as s. posterius when the bands of tissue occupy the posterior or deeper portion of the conjunctival sac; s. anterius when the bands cross the anterior or upper portions of the conjunctival sac; and s. totale when the sacs are abolished.

OPERATION.—An operation for the correction of symblepharon must not be attempted until all inflammatory action concerned in the production of the symblepharon has entirely subsided. The process must have reached a state of rest.

In operating for the correction of s. anterius it is sufficient to cut the bands with the scissors close to the conjunctival surface on each side, and to keep the parts separated until healing results, by passing a probe between the surfaces from day to day.

Operation for S. Posterius.—Dissect the adherent tissue from the globe so that the eyeball may move freely, loosen the bulbar conjunctiva in the vicinity from the subconjunctival tissue, and bring the edges of the flap into apposition by fine sutures. The palpebral conjunctiva should be made to cover as much of the palpebral wound as possible.

Tweedy separated the band of adhesion from the eyeball and passed the needles of a double-armed silk suture through the apex of the adhesion-band, forming a loop on the epithelial surface. The needles were

then carried through the lid parallel to each other, entering at the bottom of the cul-de-sac and emerging on the surface near the margin of the orbit. The threads were then tied over a piece of drainage-tube, drawn into the apex of the band deep down into the cul-de-sac. This having been done, the gap in the ocular conjunctiva may be filled by one of the methods devised by Mr. Teale—viz.:

Teale's Operation.—An incision is made along the margin of the cornea if the band of tissue has encroached upon it, leaving the apex of

FIG. 79.

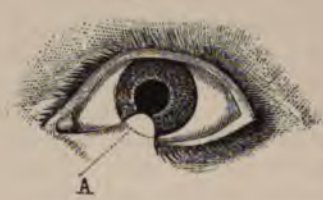


FIG. 80.

the band on the cornea. The lid is then freed so that the eyeball can move perfectly. Two flaps are now formed from the ocular conjunctiva, one from each side of the space from which the band of tissue forming the symblepharon has been removed. Each flap is sufficiently long to reach across the gap, and sufficiently wide to cover one-half of the defect. The base of one flap is made to occupy one-half of the margin of the defect on one side, and of the other flap one-half of the defect on the other side. The flaps being thus dovetailed over the defect, their apices are fixed to the healthy conjunctiva on opposite margins, and their borders attached to each other and to the subjacent tissue by means of fine silk sutures. The defects caused by the removal of the flaps are closed by sliding the conjunctiva over them and fixing the margins in apposition by means of sutures (Figs. 79, 80, and 81).

FIG. 81.

A second operation devised by Teale is as follows: The adhesion of the lid to the eyeball is thoroughly dissected away. A ribbon-like flap of ocular conjunctiva, about 6 mm. wide and extending around the cornea, is then made, with pedicles on each side of the original defect. The incisions are made with a very sharp scalpel, the inner incision beginning in the gap and passing around the cornea close to its margin, the outer beginning and ending in healthy conjunctiva, leaving a sufficient pedicle. The separation of the flap is completed with the scissors. The subconjunctival tissue is not disturbed. Before separating the flap two sutures are inserted into its upper and lower margins near its middle to keep it from rolling up and to facilitate its manipulation. The sutures are tied in a single knot after they are passed through the conjunctiva, and the needle is retained in order that these sutures may be employed for keeping the flap in position. After the flap is detached it is lifted

over the cornea into the defect and fixed by numerous sutures. Care should be taken not to render the flap too tense.

The transplantation of flaps without a pedicle has been largely practised with rather indifferent success. Mucous membrane from the mouth, vagina and prepuce, and from the conjunctiva of the rabbit has been employed.

Snellen has recently used a flap with a pedicle from the neighboring skin, pushing the apex through a buttonhole in the lid and fixing it so as to cover the gap previously made in the conjunctiva. Harlan and Noyes have done similar operations.

Thiersch's grafts have been employed to close the gap formed by detaching the adhesions, with, however, but moderate success. The great trouble experienced in closing such a gap by a flap, with or without a pedicle, is the tendency of the flap to shrink. There are no fixed points by which it may be kept extended; the conjunctiva and immediate tissues are freely movable; consequently a tendency to shrinkage finds no resistance, and the flap becomes very small, and in some cases seems to disappear entirely.

Mr. Hunt of Manchester operated with some success in the following manner: The base of the adhesion was punctured, and a probe was passed through the opening every day until the canal became lined with epithelium and suppuration ceased. The adhesion was then divided from this canal, and the surfaces kept from healing by separating them with a probe daily. Instead of the daily passage of the probe, a leaden wire has been passed through the base of the adhesion until a canal is formed and is lined with epithelium. The adhesion is then divided from the canal. It is well known that adhesions show no tendency to recur by closure from the bottom when such a cicatrized canal has been formed.

Ammon operated for symblepharon as follows: A V-shaped portion of the lid, having its base at the palpebral margin, and including the adhesion and the whole thickness of the lid, was cut out and the lid made to come together over the gap, and held in place by the twisted suture. After six to ten days had elapsed and firm union had taken place, the second step in the operation, which consisted in dissecting out the adhesion and the V-shaped piece of the lid, was performed. This can apply only to lids which are very lax.

Many devices for covering the defect made by separating the bands in symblepharon with integument obtained from neighboring surfaces have been resorted to.

Distichiasis is characterized by the presence of a double row of lashes, the outer one of which holds the normal relation to the eye, while the inner impinges on the cornea. The condition is sometimes congenital, more often acquired.

Trichiasis.—A malposition of a portion of the eyelashes, usually accompanied by irregular curving. It is a condition approaching entropium, and, like entropium, is produced by blepharitis marginalis, trachoma, injuries, burns, etc. In trichiasis the lashes are often atrophied, but they may be abnormally large.

Operation.—The operative procedures peculiar to distichiasis and trichiasis are—epilation, excision of the follicles, and removal by elec-

trolysis. Other operative procedures, such as will be described under the head of Operations for the Correction of Entropium, may also be employed.

Epilation is performed by seizing the lashes with a suitable forceps, and removing them by pulling in the direction of the axis of the hair-follicle.

In performing operations on the lids of whatever nature it is desirable to protect the globe from the possibility of injury by the insertion

FIG. 82.

Jaeger's lid-horn.

of a thin metal or bone plate into the conjunctival sac between lid and globe. Jaeger's lid-horn (Fig. 82) is suitable for this purpose. Knapp's

FIG. 83.

Knapp's modification of Snellen's lid-clamp.

modification of Snellen's lid-clamp (Fig. 83) is superior where it can be employed, as it serves to control the hemorrhage as well as to protect the globe. The operator's finger will often serve best in short operations.

Excision or *ablation* is a proceeding to be employed under the most extreme necessity. It will rarely be required if one is familiar with all possible methods, of which some are not here described.

Electrolysis.—The writer has been much gratified by the results obtained in a number of cases of trichiasis by the employment of this method. The procedure gives the patient some pain, but it can easily be borne. The number of cells must be large enough to decompose the tissues with energy.

Entropium is of two varieties, spasmodic and cicatricial. The former is temporary and acute, the latter chronic. The former occurs in children with keratitis and in old people from relaxation of tissue. In the latter the tarsus is thickened, narrowed, and abnormally bent inward, causing the edge of the lid to rub against the eyeball. Trachoma is a frequent cause.

OPERATION.—We chiefly have to deal with the lower lid. Pass a single suture parallel to and about 3 mm. below its margin deeply through the integument; tie it down tightly to pucker about 4 mm. of the skin.

A second operation, which usually succeeds if the first is not sufficient, is to remove an elliptical piece of skin, the long axis of which is perpendicular to the margin of the lid, from the lower lid; its length should be about 5 mm., width about 3 mm., and should include the subcutaneous tissue and fibres of the orbicularis palpebrarum muscle; two or three stitches are inserted parallel to the margin of the lid, including the deep tissues.

Cicatricial Entropium.—The operations for the relief of this condition are based on one of the following principles: First, removal of the lashes and their follicles, the operation known as scalping and referred to under Trichiasis, and only suitable as a last resort; second, transplanting the lid border with the lashes in such a way that they will not come in contact with the cornea (Arlt-Jaesche); third, everting the margin of the lid by attaching the integument of the marginal part to the upper part of the tarsus, thus drawing the lashes away from the cornea (Hotz); fourth, excising a wider section or all of the tarsus and turning it up (Streatfield-Pope); fifth, dividing the tarsus horizontally on its inner surface, bending it outward, and holding it by sutures (Green); sixth, spreading the intermarginal space by transplanting strips of skin to it. All of these operations are painful and should be done under the influence of ether.

According to the severity of the condition will a choice be made among the various methods. We shall designate three methods suited—1st, to mild cases (Hotz), 2d, to severer cases (Green), and, 3d, to the very bad cases (Scimemi); and as to ablation of lashes, this finds utility in cases of such deformity that the shortened and incurvated lids are quite as responsible for the corneal mischief as are the lashes, and their removal does only a little service.

The well-known method of Arlt-Jaesche has proved not to have enduring effects, and, even as modified by the insertion of strips of skin at the ciliary margin, it yet fails to counteract permanently the tendency of the contracting conjunctiva to re-establish the deformity. An accident not infrequent is sloughing of the transposed ciliary border and unpleasant deformity.

The Hotz operation consists in fixing the flap containing the lashes to the free border of the tarsus and the tarso-orbital fascia. A horn-plate or clamp is placed in position and the integument of the lid put on the stretch; a curved incision is now made, starting near one angle of the eye, about 4 mm. from the free border, and describing a curve corresponding to the curve of the free border of the tarsus, but about one-third of the distance between the free border of the tarsus and the margin of the lid. If the integument is abundant, a narrow crescentic piece may be removed—usually this is not necessary; the subcutaneous tissue, down to the tarsus and tarso-orbital fascia, is next removed, and the flap containing the lashes is attached to the upper part of the tarsus and tarso-orbital fascia by three silk sutures. The sutures pass through the integument, superficial portion of the orbital border of the tarsus, and

fascia, and emerge through the integument at the upper border of the wound very near its edge. The suture does not include the fibres of the orbicularis nor the connective tissue of the lid.

The Streatfield-Pope operation excises a wedge of the tarsus, whose base is upon the anterior surface and bends the tarsus outward by sutures. The same intent is more effectually secured by Green's method, which is a modification of Burow's (1843), and with which excision of a strip of tarsus may if needful be combined.

Green's proceeding is as follows: The lid is everted and held by the fingers or by fixation forceps. With a scalpel or Beer's knife an incision is carried through the whole length and thickness of the tarsus on its conjunctival surface, about 2 mm. above and parallel to its free border. Then, returning the lid, a strip of skin 2 mm. or less in width, excluding muscular fibres, is taken out along a line 1.5 mm. above the cilia from end to end of the lid. Three sutures are next inserted by a curved needle in the following manner, it being remembered that the ciliary border is now quite loose, held in place by its ends and by the intact muscular fibres: The needle, held by proper forceps, is inserted into the conjunctival edge of the free piece, brought around so that the thread lies on the marginal surface, and the needle passed into the skin-wound, grazing the upper part of the tarsus, pushed well up, and emerges halfway up to the brow. A knot is tied so tightly as fully to evert the cilia without strangulating the tissues. Then a dressing of cotton and collodion is placed over the lashes and the wound. This dressing holds down the lashes upon the skin, seals the wound, and contributes most materially to success. The sutures may be removed in twenty-four hours and the collodion cotton dressing renewed. The tarsal wound gapes and fills with granulations. Canthoplasty may be combined with the proceeding.

Many operations for the transplantation of a strip of tissue to increase the intermarginal space have been devised. Scimemi[1] splits the intermarginal space, so that it will gape about 2 mm., and fills it in by a flap about 1 mm. wide and 2 mm. below the lashes. Sufficient freedom must be secured at the ends of the flap to lift it over the lashes and fix it in position in the intermarginal groove, either by fibrinous adhesion or by fine sutures; the wound in the integument is closed by sutures. After four or five days the connection of each end of the flap may be cut away, the vacancies brought together by sutures, and the little strip henceforth belongs to its new abode. The results are usually good. When the palpebral fissure is shortened, as it frequently is in cases of cicatricial entropium, the operation for entropium is supplemented by canthoplasty or canthotomy. Canthotomy is also done to relieve the tension on the cornea sometimes present in high degrees of inflammation of the lids.

In performing canthotomy a speculum may be used to hold the lids apart, or the lids may be made a little tense by drawing them inward with the fingers. The point of a strong pair of scissors is inserted beneath the external commissure and pressed outward to the bottom of the conjunctival fold in the direction of the palpebral fissure, the tissues being then divided. The lids spring apart, but the orbicularis muscle still acts, and will do so until the outer canthal ligament is divided. This is done by passing the blades of a pair of strong, sharp-pointed

[1] *Bull. d'Ocul.*, Firenzi, xi., 1889.

scissors to the orbital margin, including the fibrous structures between conjunctiva and integument within the blades, entering at each side of the wound made by the division of the commissure, and dividing the tissues.

The canthotomy is converted into a *canthoplasty* by dissecting the integument and the conjunctiva from the underlying tissue, bringing their edges together by two or three fine silk sutures, and securing them in this position. The healing after canthotomy results in no marked permanent enlargement of the fissure. After canthoplasty the fissure is enlarged to the extent of the plastic procedure, but is liable to become shortened again.

Ectropium.—Eversion or turning out of the lid is usually the result of cicatricial contraction of the integument, sometimes due to hypertrophy of the conjunctiva and sometimes to a paralysis of the muscles supplied by the facial nerve.

Numerous operations, nearly all of which imply the transplantation of a flap, are practised for the correction of this condition.

Ectropium due to hypertrophy of the conjunctiva affects chiefly the lower lid. It is sometimes sufficient to excise a narrow strip of the hypertrophied membrane parallel to the margin of the lid. The effect may be greatly increased by stitching together the conjunctival wound and passing both ends of the suture down to the orbital edge, emerging in the skin and tying them over a roll of plaster.

In cases of paralytic ectropium it frequently becomes necessary to remove a V-shaped piece of the lower lid and to shorten the palpebral fissure. The operation is performed as follows: A V-shaped piece of the entire thickness of the lid, its base corresponding with the margin of the lid, its apex to the bottom of the conjunctival sac, is excised. The sides of the wound are then brought together by three or four sutures, which are passed through the integument and deeper tissues, avoiding emergence on the conjunctival surface. The sutures are tied sufficiently tight to bring the edges into apposition. If there is much strain on the lid, a hare-lip needle may be employed in place of the marginal suture. Tarsorraphy is performed to shorten the palpebral fissure.

The operations for the correction of cicatricial ectropium are of the plastic variety and are exceedingly numerous.

The Wharton-Jones operation, originally designed for the upper lid, is applicable to the lower lid alone, and is effective only in cases of slight deformity. It consists in making a V-shaped incision through the integument, the base of the V being at the margin of the lid and broad enough to include the ectropionized part, the apex extending downward upon the cheek. This flap is then dissected upward toward its base. The integument bordering the outer margins of the wound is dissected up and the margins are brought together. When the wound is closed the line of incision resembles a Y instead of a V, as at first (Fig. 85).

Another classical operation is that of Dieffenbach, and this likewise is suited only to cases of little deformity and involving the lower lid: most text-books describe and picture it.

Flaps employed in the above manner shrink considerably, and the direction of the tension is toward the pedicle, and often reproduces the ectropium. Flaps taken from the adjacent skin of the cheek, forehead,

lids, or temple in such a manner that the pedicle lies near the outer or inner canthus, so that traction from shrinkage, should it occur, will be in the direction of the axis of the palpebral fissure, and will tend to keep the lids against the globe, are greatly to be preferred. In dealing with cicatricial ectropium it is always necessary to separate the margin of the

FIG. 84. FIG. 85.

Wharton-Jones operation for ectropium.

lid and the remaining true tissue of the lid from the cicatricial tissue. As much of the cicatricial tissue may be removed as is deemed advisable. It is quite evident that if the entire adjacent tissue is cicatricial, removal of the whole is out of the question. Flaps with a pedicle are advisable in all cases where they can be secured from healthy skin from the adjacent tissue. In some cases all the adjacent tissue is cicatricial. (If this be thick and apparently well vascularized, it may be utilized for a flap, always anticipating an unusual amount of shrinkage.) It then becomes necessary to employ flaps without a pedicle. The defect made by detaching the lid from its adhesion may be filled by small skin-grafts (Reverdin's method), employing the epidermis, rete, and apices of the papillæ (epidermic grafts) or the entire thickness of the skin (dermic grafts), or the flap may be large enough to cover the whole defect. Thiersch's method consists in employing large epidermic grafts made with a large sharp knife or razor, shaving the epidermis from the skin. When large dermic grafts are used the method is commonly known as Wolf's method. The flap as marked out on the skin should be somewhat larger than the area to be covered, as there is some contraction of the skin immediately on removal. The flap should be removed as quickly as possible consistent with careful dissection, and should be kept warm by means of sterilized absorbent cotton and sterilized normal saline solution or a 2 per cent. solution of boric acid, sterilized. No time should be lost in getting the flap in position when it is once dissected off. If subcutaneous tissue has been removed with the flap, it should be snipped off by means of small scissors curved on the flat. When put in position no sutures need be employed unless it is necessary to hold the flap into a depression, when a loop suture may be used. Sterilized rubber gauze or oil silk may be laid over the flap, extending to the neighboring skin, and a dry sterilized

gauze and cotton dressing applied. The flap becomes adherent in forty-eight to seventy-two hours, but it is best not to remove the dressing under five days if no reason for doing so is apparent. The ultimate shrinkage has been estimated, by careful observation in a number of cases, to be about one-fifth of the area of the flap as marked out on the skin before removal.

Injuries and Wounds.

Injuries and wounds are treated as they would be in any other part of the body, by cleansing with antiseptic washes and stitching together. If the whole lid should be torn across, the conjunctiva must first be stitched together and the skin-wound united subsequently. Only in this way can serious deformity be avoided.

Tumors of Eyelids.

Epithelioma, *Sarcoma*, and *Papilloma* are treated by excising and the transplantation of a flap if necessary, with or without a pedicle as the case may be. If necessity require removal of a piece, including the whole thickness of the lid, the canthal ligament at the opposite end of the lid must be divided to control the pull of the orbicularis muscle. Such cases sometimes require extensive operations.

Nævi.—Simple excision may be employed for the removal of the greater number of these growths. Electrolysis may be employed for some.

Conjunctiva.

Pinguicula (from *pinguis*, fat).—A small, yellowish-white, connective-tissue tumor which appears usually in the nasal portion of the ocular conjunctiva on the horizontal meridian, but may also occur on the outer portion of the ocular conjunctiva. It very seldom becomes as large as a grain of wheat. Removal is seldom necessary. When advisable, simple excision will suffice.

Fig. 86.

Pterygium.

Pterygium.—A triangular fold of mucous membrane which pushes itself upon the cornea, usually from the inner angle, but occasionally from other directions (Fig. 86).

Operations for its removal are performed under cocaine. They are—

First, Excision.—After inserting a lid-speculum the pterygium is seized with a pair of fine-toothed forceps by its upper and lower margins near the cornea, and the corneal portion separated by means of a small sharp-pointed knife: a Beer's cataract knife is an excellent instrument to employ. The tissue beneath the pterygium is pierced with the point of the knife at the corneal margin, and by cutting toward the pupil, all of the apex of the pterygium, together with the superficial layers of the substantia

propria of the cornea, is detached. The dissection is continued, with the scissors away from the cornea, in the upper and lower folds of the pterygium, for a distance of 2 to 8 mm. By bringing the incisions together in the horizontal meridian near the caruncle, so as to include a large portion of the body of the pterygium, a diamond-shaped piece is removed. The subepithelial hypertrophied tissue of the pterygium should be included in the piece removed. The conjunctiva at the margins of the wound should be undermined and the edges brought together by means of fine silk sutures. An antiseptic dressing should be applied. The sutures usually drop out in a few days, or they may be removed on the fifth or sixth day. Arlt suggests that the wound in the ocular conjunctiva be made rhomboidal, which certainly gives a smoother cicatrix.

Second, transplantation, first suggested by Desmarres, may be performed as follows: The apex of the pterygium is detached from the cornea, or may be pulled from it, as above described, and is dissected well back toward its base. The hard mass at the apex and a portion of the hypertrophied tissue are removed, the pterygium being converted into a long-pointed flap of mucous membrane less thick than the original body of the pterygium. The conjunctiva adjacent to the margin of the wound is dissected free from the underlying tissue, so that it may be made to fill the defect due to the removal of the pterygium. An incision is now made through the conjunctiva diagonally downward and toward the vertical meridian of the globe, beginning in the incision at the lower margin of the pterygium, near its base, and reaching to the bottom of the cul-de-sac. The opening thus made usually gapes sufficiently wide to receive the flap made from the pterygium. A suture is passed through the apex of the flap and through the conjunctiva at the end of the incision, and tied, drawing the flap downward into the triangular space. The remaining wound is closed by means of sutures. It is held by many that this method, by directing the remaining tissue of the pterygium away from the cornea, is less often followed by return of the growth.

Foreign bodies in the conjunctiva are usually removed by means of the spud, or by forceps and scissors.

Tumors of the conjunctiva require no special consideration.

Trachoma (syn. Granulated lids).—A condition due to a deposition of lymphoid elements in the conjunctiva of the lids and retrotarsal folds.

Surgical Treatment.—This may be divided as follows:

1st, Partial removal by excision (Galezowski).

2d, Partial removal by expression (Noyes, Knapp, and others).

3d, Scarification and electrolysis (Johnson).

4th, Brushing with a stiff bristle-brush (Manolescu).

5th, Destruction of individual granules by galvanic cautery (Reich).

6th, Partial removal by scarification and the brushing in of a germicide (Abadie).

First, Excision.—With the patient under ether and in the recumbent position, the male blade of Galezowski's forceps (Fig. 87) is introduced to the bottom of the cul-de-sac, the lid being everted. The retrotarsal fold is drawn out and the forceps fixed over it, and the redundant membrane excised. This method should never be employed unless there is

a very loose and abundant retrotarsal fold, and excision must be practised sparingly.

Second, Expression, suitable for the first stage of trachoma and for the state called "folliculosis" at any period.—It consists of squeezing

Fig. 87.

Galezowski's forceps.

out the contents of the trachoma-follicles by compressing them between the blades of suitable forceps. Prince, Noyes (Fig. 88), Knapp (Fig.

Fig. 88.

Noyes' forceps.

89), and others have devised forceps for this purpose. The operation is painful and should be done under the influence of ether.

Fig. 89.

Knapp's forceps.

In the use of Noyes' forceps the lids are everted and the folds of conjunctiva are caught between the blades of the forceps, and by a gentle stripping motion the contents of the follicles are forced out. Two forceps are generally used, and as a fold of conjunctiva is about to escape from one it is seized by the other. The surface is washed with a mild antiseptic solution afterward and the patient is dismissed. The after-treatment consists in the frequent use of a boric-acid solution to ensure cleanliness, and the application of a solution of the nitrate of silver, 1 per cent., once daily for a few days. If plastic adhesions occur, they should be broken up by sweeping a probe through the cul-de-sac.

Third.—G. L. Johnson of London treats trachoma by scarifying the affected tissue in equidistant grooves parallel to the margin of the lid. After the bleeding has ceased he passes along the grooves a current strong enough to produce decided electrolytic action, by a double-pointed electrode attached to the negative pole of a battery. The surface is cleansed and dusted with calomel. An ointment composed of hydronaphthol 1 to vaseline 800 is freely applied and the eyes bandaged. After-treatment as in No. 2.

Fourth.—Destruction of the trachoma-granules by means of the galvano-cautery or the Paquelin cautery. Individual granules are pierced and destroyed. Many sittings are necessary.

Fifth.—Partial removal by means of scarification and rubbing with a brush dipped in a germicide. The operation met with its fullest development in Abadie's Clinic, Paris, and was termed "grattage." It is applicable during the first and second stages, and in the following modified method may give excellent results: With the patient under ether the

FIG. 90.

Weeks' grattage knife.

lids are everted by Gibson's forceps, over which the lid is rolled. All the affected portion of the conjunctiva is then superficially scarified in transverse lines and about 15 mm. apart. It is wise at this

FIG. 91.

Weeks' lid forceps.

stage to employ expression if trachomatous tissue can be easily removed in that manner. With a moderately stiff tooth-brush a solution of sublimate, 1 : 500, is now brushed into the tissue of the conjunctiva, as little force as possible being used. After this is done the conjunctival sac is cleansed with an antiseptic solution and the eyes bandaged. After twenty-four hours have elapsed the bandage is removed, the treated surfaces separated from each other by sweeping a probe well lubricated with vaseline or ung. boracici, 10 per cent., through the conjunctival sac, and the surfaces of the lids are rubbed with a sublimate solution, 1 : 500. The bandage is left off, and the eyes are bathed in a boric-acid solution, 3 per cent., two or three times daily. The reaction is slight, and under proper after-treatment recovery occurs in a few weeks. Relapses sometimes take place. Brushing too vigorously will leave bridles of adhesion, and perhaps restraint of movement of the globe. A large observation has considerably qualified the hopeful expectation at first entertained, especially when cases are seen one or two years after the operation. Cicatricial tissue is always to be looked for in greater or less amount, aggravating the natural tendency of the disease.

Diseases of the Cornea.

Staphyloma.—A bulging of the cornea (not including conical cornea), total or partial, dependent on a thinning of its tissue due to precedent inflammation.

Critchett's Operation.—With the patient under the influence of ether the lids are fully separated with a speculum. Four or five small curved needles are now passed through the tissue of the globe, entering and emerging at opposite points and at such a distance from the base of the protrusion that they will be outside of the line of incision. An elliptical piece is now removed by means of the knife and scissors. The major axis of the ellipse lies in the horizontal meridian. The edges of the wound should be so shaped that when brought together they will lie in perfect apposition and will be as regular as possible. After the

Fig. 92.

Operation for staphyloma: needles introduced.

removal of the staphyloma the needles, bearing silk sutures, are drawn through, and the wound closed by tying the sutures. Antiseptic precautions should be carefully observed. A compress bandage is applied after

Fig. 93.

Operation for staphyloma: sutures tied.

the operation. In passing the needles for this operation the ciliary body should be avoided if possible. But little vitreous should be permitted to escape. The sutures are removed at the end of ten days or two

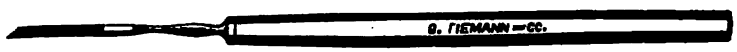
weeks. This method gives a good stump for the wearing of an artificial eye (Figs. 92, 93). Some cases of sympathetic ophthalmia have followed its execution.

Operations for staphyloma, such as have been described, are suitable only for those cases where the disease is confined to the anterior portion of the globe. If deep-seated disease is present, enucleation is to be preferred.

Opacities of the Cornea.

In certain cases of dense white opacities of the cornea it is desirable for cosmetic purposes to tattoo the surface to produce the appearance of a pupil; this is done as follows: In most cases cocaine anæsthesia is sufficient, and the cornea is dried with absorbent cotton squeezed out of a boric-acid or sublimate solution. A thick paste, made by dissolving the

Fig. 94.



Baader's tattooing needle.

best India ink in distilled water, is applied to the centre of the cornea. With a bunch of needles (Fig. 94) as much ink as possible is driven into the epithelium and the superficial layers of the cicatrix by thrusts at varying angles, and only one sitting should be needful. The superfluous ink is washed away. The reaction is unusually slight. Rarely will the operation have to be repeated if done as described.

Conical Cornea.

A conical central protrusion of the clear cornea not due to ulceration.

For the purpose of limiting the advance of the disease iridectomy and iridodesis have been performed.

Von Graefe devised the following operation for the purpose of reducing the height of the cone by producing ulceration at the apex and a subsequent cicatrix: With a Graefe knife (Fig. 97) a small flap is made at the apex of the cone, care being taken not to perforate the cornea. If perforated, the operation is delayed for several days. The surface thus created is touched with the mitigated stick of nitrate of silver very lightly, the effect of the silver being neutralized by a solution of sodium chloride immediately. The caustic is applied at intervals of from three to six days for a sufficient period to produce a slight opacity at the apex of the cone. The eye is now treated by mild antiseptic measures, accompanied by the use of atropine in cases where some reaction has been produced. As the ulcer cicatrizes the cone is diminished in size and a marked improvement in vision occurs. Six weeks to two months are required to obtain the maximum result. It is often necessary to perform iridectomy after this procedure to produce an artificial pupil out of the line of the central opacity.

Knapp has recently employed the galvano-cautery to produce a cicatrix at the apex of the cone. The cautery is tipped with a small oval plate, and applied at red heat to the apex of the cone. The superficial

layers of the corneal tissue are destroyed. An antiseptic dressing and compress bandage are applied.

Excision of pieces of the cornea has been practised.

Mr. Critchett, Sr., practised iridesis, or iridencleisis, by which the pupil was displaced laterally and converted into a slit, but it sometimes caused sympathetic irritation. Von Graefe employed iridectomy, but the effect was to render vision worse and not reduce the conicity.

Buphthalmus.—The operative treatment, if it becomes necessary, may be enucleation, or that for staphyloma, or sometimes iridectomy.

Foreign Bodies on the Cornea.

These are usually removed by a discission needle or a spud, under cocaine anæsthesia. A good illumination is important, and requires a two-inch convex lens, either held by an assistant or attached by some contrivance to the operator's left hand (Noyes). He separates the lids by his finger, or by a speculum if unavoidable, and carefully picks out the foreign body with the least possible disturbance of the epithelium.

If the foreign body has penetrated the cornea and lies partly in the anterior chamber, Agnew has advised transfixing the cornea with a broad knife, as a Beer's cataract knife, making puncture and counter-puncture in such a manner that the blade of the knife will lie just beneath the foreign body and prevent it from slipping into the anterior chamber during the manipulation for its removal. The cornea is then cut around the foreign body, which is finally seized, either with the electro-magnet or with the forceps, and withdrawn. The magnet alone, if powerful enough, will extract bits of iron that are imbedded.

Wounds of the Cornea.

These usually close of themselves, aided by a bandage. If, however, the iris protrude, this must be replaced if possible, or if not possible it should be excised deeply. For excision seize the iris lengthwise of the wound by fine iris forceps, pull gently, and cut close to the cornea with fine scissors curved on the flat.

It may be advisable to close a wound in the cornea by means of a fine suture, but this is seldom resorted to. Careful cleansing of the wound, the removal of shreds of tissue, and the application of a compress bandage are usually sufficient.

Diseases of the Sclera.

Staphyloma of the sclera consists either of implication of adjacent parts in staphyloma of the cornea or of an isolated tumor consequent upon cyclitis. These conditions call for removal of the globe when surgical measures are resorted to.

Wounds of the Sclera.

If small, all that is required after cleansing the wound is to apply a compress bandage. Large incised wounds, not involving the ciliary body, if not accompanied by infection, may be closed with sutures. The wound is carefully cleansed with an antiseptic solution, its extent is

brought into view by carefully dissecting aside the conjunctiva, and the margins of the scleral wound brought together by fine catgut sutures. The wound in the conjunctiva is closed with fine silk sutures. Rupture of the sclera may occur without laceration of the conjunctiva, and needs no treatment except that the severity of the injury often renders removal of the globe necessary.

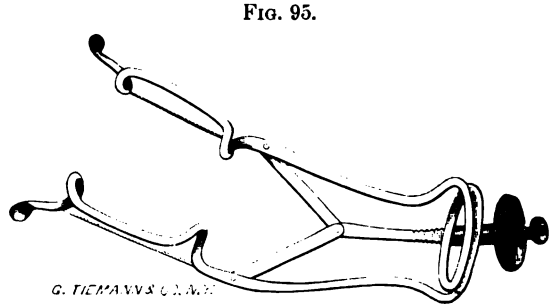
OPERATIONS ON THE IRIS.—The operations of the iris to be described are—

1. Iridectomy;
2. Iridodesis;
3. Iridotomy;
4. Corelysis;
5. Iridodialysis.

The operation of iridectomy requires for its performance a speculum for keeping the lids open, fixation forceps, knives for making the incision, forceps for seizing the iris, iris scissors, and a spatula for freeing the iris at the angle of the wound.

The speculum employed depends on the choice of the operator. Noyes' speculum is a very good one. In inserting the speculum the patient should be directed to look downward, and the blade for the upper lid slipped into its place. The patient should then be directed to look upward, and the blade for the lower lid be put in position. During this manœuvre the blades should be approximated. When in place the blades should be allowed to spring apart sufficiently to open the lids to the maximum without stretching them greatly.

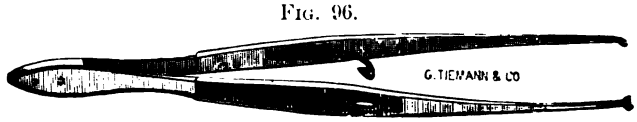
FIG. 95.



Noyes' speculum.

The fixation forceps selected should have fine-toothed blades, not too sharp. The blades should measure 3 mm. in width, set so as to easily

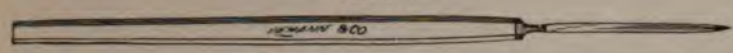
FIG. 96.



Fixation forceps.

grasp the tissue. The catch should be easy to manipulate and yet be firm

FIG. 97.



Graefe knife.

Knives.—The Graefe knife (Fig. 97) or a broad lance-shaped knife (keratome) (Fig. 98) may be used. If the lance-shaped knife is em-

FIG. 98.

Jaeger's angular keratome.

ployed, it should be straight if the iridectomy is to be made outward, but should be bent at an angle if the iridectomy is to be made in any

FIG. 99.

Iris forceps.

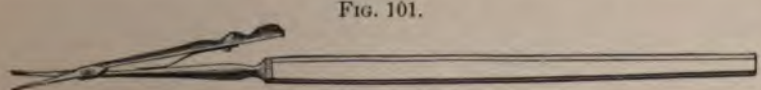
other direction. The size of the lance or keratome may vary to suit the case. The length from point to base line is from 9 mm. to 10 mm.,

FIG. 100.

Iris scissors.

and the width of base from 6.5 mm. to 8 mm., according to the purpose intended. The point must be very sharp, and the front of the blade be

FIG. 101.



Noyes' iris scissors.

thin enough to easily bend when pressed on the thumb-nail. The angle with the shank is 30° to 100°.

Iris scissors are usually small; their cutting edges should slide closely and smoothly over each other, but should not override. They may be straight, bent on an angle, or curved on the flat. The writer prefers the

latter. Very small iris scissors have been devised by Noyes and by Hall, which may be used in place of the ordinary scissors for special purposes. Wecker's pince-ciseaux are exceedingly useful and will be referred to later.

Iris forceps are of many patterns. The ordinary curved or angular mouse-toothed iris forceps is usually sufficient. Iris forceps are constructed with several teeth placed on the lower edge of the blades for seizing the iris more firmly when bound by firm adhesions, or for grasping a thickened capsule.

The conditions for the relief of which iridectomy is practised are recurrent iritis, posterior synechiæ, occlusion and seclusion of the pupil, staphyloma, conical cornea, the production of an artificial pupil in opacities of the cornea, for the removal of small tumors and cysts of the iris, and for the reduction of intraocular tension.

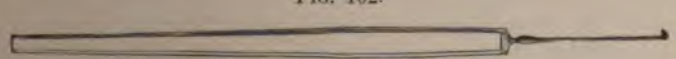
In performing the operation the patient should be placed either in the recumbent or sitting posture, the operator standing behind or at the side. Cocaine anæsthesia, using a 4 to 10 per cent. solution, may be employed, but it is difficult to render the iris insensible, particularly when inflammation of the membrane exists, and in many cases ether or chloroform should be given. The direction of the iridectomy in the majority of cases is upward and a little inward. If the keratome is employed, it is best to make the incision with the right hand, whichever eye is operated on. For making the incision the operator will find it most convenient to stand to the left of the patient and behind. When proper anæsthesia has been obtained the eye is thoroughly cleansed with an antiseptic and the stop speculum introduced. The eye is then irrigated, either with a sterilized normal saline solution, boric-acid solution, 2 per cent., or a solution of the bichloride of mercury, 1 : 5000. The conjunctiva and conjunctival tissue are now seized by the fixation forceps at a short distance from the cornea, and the patient bidden to look in the desired direction. When the proper position is secured the forceps retains it in place; it does not drag it to place. The point of the keratome is now made to pierce the globe 1 mm. away from the clear corneal margin in the limbus, passing through at nearly right angles with the surface; when within the chamber the handle of the keratome is slightly depressed, and the point is directed toward the centre of the pupil, just beneath the cornea (the point is kept in the anterior portion of the anterior chamber to avoid wounding the lens), to which point it is advanced by a slow, even, continuous movement until the keratome has entered the anterior chamber nearly to its base. Jerky or sawing movements are attended with danger to the lens. Many traumatic cataracts have been produced by faulty advancement of the keratome in making the incision. The handle of the keratome is now depressed until the point lies almost, if not quite, in contact with the posterior surface of the cornea, the aqueous allowed to escape slowly, and the knife withdrawn, making the opening larger, if it is so desired, by turning the edges into the extremities of the wound. When the keratome is withdrawn the fixation forceps may be transferred to an assistant; the operator may or may not have to change his position for the excision. The length of the wound determines the breadth of the iridectomy, and this is regulated by the width of the knife or by the depth of its entrance.

With the iris forceps held in the left hand the blades are introduced into the anterior chamber closed, hugging the cornea, until their tips reach the upper margin of the pupil; they are then permitted to spring open slowly to the desired extent. If the iridectomy is for visual purposes, a small piece of iris is seized; if the case is one of glaucoma, a large piece is seized. The iris is now slowly drawn out of the anterior chamber as far as it is prudent to avoid tearing it from its insertion. During this manœuvre the iris scissors has been held in the right hand, the blades being in easy proximity to the wound. When the iris is sufficiently far out, the scissors is opened to include it, close to the globe, and the piece of iris completely excised at one cut; or, if it is desirable to excise the piece of iris as close to its root as possible, the edge of the piece next the scissors is snipped with the points, the body of the withdrawn piece cut close to the eyeball by a second snip, and the distal edge severed by a third snip. The iris may be drawn out by the operator and excised in the manner described by an assistant. The eye is now irrigated with the antiseptic solution and the speculum and fixation forceps removed, provided the patient is under cocaine anæsthesia. The blood-clots are removed if any are attached to the wound or in the conjunctival sac, and the iris freed from the angle of the wound by gentle rubbing with a bent spatula, or its careful insertion at the ends of the wound. The sides of the defect (coloboma) should be perfectly free, and the remaining pupillary margin of the iris should be as regular as before the operation. If ether anæsthesia is employed, the fixation forceps and speculum are removed at this stage. A compress bandage is applied and changed in twenty-four to forty-eight hours. Blood in the anterior chamber may be made to escape by gentle pressure on the cornea, either by rubbing the lids over the cornea or by pressure on the cornea with the spatula. If some blood remains, it is soon absorbed under the influence of a compress bandage. If the quantity of blood be large, forcible irrigation upon the surface of the wound will expel some of it.

The size and position of the iridectomy should vary with the object for which it is made. If it is for the purpose of arresting inflammation or for visual purposes, it should be small and in a position most suitable for accomplishing the purpose—for an artificial pupil downward and inward; for glaucoma, upward. The portion of iris removed in glaucoma should be about one-fifth of the whole, from 5 to 7 mm. The incision should be in the sclerotic just anterior to the root of the iris. For artificial pupil the incision should be at the sclero-corneal margin.

In many cases it will be found best to make the incision with a Graefe cataract knife; there is less danger of wounding the lens. In cases where the anterior chamber is shallow the keratome cannot be used with any degree of safety. Where a pupil for visual purposes only is required,

FIG. 102.



Tyrrel's blunt hook.

a very small incision may be made, and a small blunt hook made of silver or platinum may be passed into the anterior chamber, hooked over the

free margin of the iris, the iris pulled out through the wound, and cut off with iris scissors.

When occlusion of the pupil or posterior synechia is present it is

FIG. 103.

Wecker's iridotomy scissors.

often necessary to employ Liebreich's forceps to draw the iris from its attachments.

Iridodesis.—This operation was much practised prior to 1870, but has now become obsolete. It consists in drawing out a small piece of iris at its free margin through a small incision in the cornea, and confining it there by a suture tied firmly about the iris. The iris is allowed to heal in the wound.

Iridotomy.—This operation consists simply in an incision through the iris. It is evident that the lens, were it in position, would be wounded. The operation is therefore only suitable for aphakial eyes. It is resorted to when the pupil has become occluded by inflammatory exudation and the iris and exudation form a diaphragm more or less dense between the anterior and vitreous chambers. The operation may be done by entering through the sclerotic or through the cornea. Cheselden employed a sickle-shaped knife and entered the eye through the sclerotic, as in the operation for couching the lens. He passed the point through the iris at its tense part, then by a gentle sawing motion an incision was made through the iris horizontally, 3 to 5 mm. in length.

The operation may be performed by thrusting a very narrow and sharp Graefe knife through the cornea midway between the centre and the sclero-corneal margin and dividing the iris at its tense part. Push the knife deeply and cut as it is withdrawn.

De Wecker has devised a scissors forceps for performing iridotomy and for dividing dense membranes occupying the pupillary space. The operation consists in an incision by a narrow keratome through the cornea at its margin, at the desired part of the circumference. Withdraw a little, and then push the point through the iris or membrane. The scissors is introduced through the corneal opening, and one blade through the iris opening, the other blade lying above, and the scissors is then closed, cutting through the enclosed portion of tissue. If the single incision is not sufficient, a second or third cut is made by changing the direction of the scissors. The result of iridotomy is an elongated opening forming a pupil, which may remain open, but often closes by subsequent inflammatory action. The method by Wecker's scissors gives the best opening for severe cases, and one most likely to remain permanent.

Corelysis.—An operation for detaching the iris from the lens in cases of posterior synechia ; it is but little practised at present, a small iridectomy being preferred. The operation is as follows : Atropine having been instilled for the purpose of locating the synechia, a small opening is made in the cornea near its margin at a point between two adhesions,

and the aqueous is permitted to escape. A hooked spatula is now introduced, and is worked behind the synechia under the iris. A little pressure in the direction of the pupil now serves to detach the adhesions in the greater number of cases. If this does not suffice, the synechia is caught in the hook and by gentle traction is broken through. Care must be observed not to injure the capsule of the lens. After the operation atropine must be instilled.

Iridodialysis.—This operation is seldom called for, but in cases where the opacity of the cornea covers almost its entire surface, and only a narrow rim of clear corneal tissue remains, the operation may be performed as follows: An incision is made through the cornea at a suitable place to permit of effective use of the iridectomy forceps or hook. The hook (Fig. 102) or forceps is now introduced, the iris seized at its root and gently torn from its insertion, then partly drawn out, and a suitable piece excised. If opacity in the vicinity of the wound follows, it will be sufficiently removed to be out of the way of the clear cornea.

GLAUCOMA is a disease the treatment of which is essentially surgical. Its symptomatology and etiology may be briefly treated of. The disease is characterized by an increase in the intraocular tension, either continuous or intermittent.

The disease may be classed, according to its quality, into—1st, simple; 2d, inflammatory; 3d, secondary; 4th, hemorrhagic. According to its stage or intensity the simple presents various degrees culminating after a chronic course in absolute glaucoma. The inflammatory may be subacute, acute, or fulminating. Hemorrhagic glaucoma may eventuate in inflammation. Secondary glaucoma ensues from some preceding disease.

First.—Simple chronic glaucoma occurs most frequently in hypermetropes, but is not confined to them. It is very insidious in its progress, and is frequently accompanied with little or no pain. A very gradual diminution in vision or rapid increase of presbyopia is not infrequently the first indication of its existence to the patient. It may exist two or three years before sufficient notice is taken of the condition to send the patient to a physician. In the early stage the tension may be somewhat increased over the normal; there may be a slight contraction of the visual field, most marked on the nasal side and above; the anterior chamber becomes a little shallow; and by the ophthalmoscope the optic disk will be found to be cupped. Slight neuralgic pains in the region of the eye, temple, and forehead are frequently experienced. If these do occur, they are usually attributed to disturbances of digestion. The symptoms above mentioned, except the pain and the tension, gradually increase until total loss of vision results.

Second A.—In subacute inflammatory glaucoma attacks are experienced at intervals, accompanied by marked loss of vision and increase in intraocular tension; the pain is frequently intense. The anterior chamber becomes shallow, the cornea steamy, the refractive media very hazy. If the disease has lasted some time, cupping of the optic disk is present. The attack subsides, but is always liable to return.

Second B.—Acute inflammatory glaucoma implies a sudden and violent attack, with extreme loss of vision. It is seldom accompanied with cupping of the disk, the pain is intense, intraocular tension high, cornea steamy, anterior chamber shallow, pupil dilated and oval.

Second C.—Fulminating glaucoma expresses a still more severe phase of acute glaucoma, especially as to the degree of pain. Vision may be destroyed in twenty-four to forty-eight hours from the extremely high tension.

Third.—Hemorrhagic glaucoma is a condition in which hemorrhage, usually from retinal vessels, has preceded the attack of glaucoma. It may be accompanied with severe pain. In the great majority of cases it destroys vision.

Fourth.—Secondary glaucoma is a condition of increased tension, with the resulting disastrous effects, excited by some previous condition of the eye. It may follow a kerato-iritis, an extensive ulcer of the cornea, a wound of the globe, dislocation of the lens, the presence of a foreign body in the eye, cataract extraction, hemorrhagic retinitis from whatever cause, insufficiency of the aortic valves, intraocular tumors, etc. Congestion of the ocular conjunctiva and all the symptoms of idiopathic glaucoma may be induced.

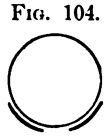
Fifth.—Absolute glaucoma is the condition present after the anatomical changes have become profound and destruction of vision complete.

Glaucoma is seldom met with in youth, usually being confined to the middle-aged and the old. If a cure is effected, it will be secured only by operative procedure. Iridectomy is the operation which promises most; it should be done so that about one-fifth of the iris is removed without leaving much of the iris-root. The results are best when the operation is performed at an early stage of the disease.

Anterior and posterior sclerotomy are practised for the cure of glaucoma.

Anterior Sclerotomy.—The pupil should be contracted by the instillation of a solution of eserine. Cocaine anæsthesia may be employed. The lids are held apart by a speculum and the eye fixed with forceps. With a narrow Graefe knife a puncture is made at a point 2½ or 3 mm. above or below the horizontal meridian of the cornea and through the sclerotic 2 mm. back of the clear corneal margin: the point of the knife crosses the anterior chamber to make the counter-puncture at a corresponding point. By a gentle sawing motion the tissues are cut in this plane until but a few fibres of the sclerotic remain. (Usually the edge of the knife may barely be discerned through the remaining fibres.) The knife is then turned to cause the wound to gape, and the remaining aqueous is permitted to escape. The knife is then withdrawn. The operation should not be attempted if the anterior chamber is too shallow to permit of the passage of the knife; there should be no incarceration or prolapse of the iris.

FIG. 104.



Incision in sclerotomy.

Posterior Sclerotomy is sometimes resorted to, and is performed as follows: The eye is rotated upward, and by a meridional incision through the conjunctival and subconjunctival tissue the sclerotic is laid bare between the external and inferior recti muscles. A Graefe knife is then thrust through the sclerotic, choroid, and retina into the vitreous chamber, entering near the equator of the globe, producing a meridional

incision 6 or 7 mm. long. The knife is withdrawn and an antiseptic dressing applied.

Sympathetic Ophthalmia is a condition of either sympathetic irritation or sympathetic inflammation in a previously healthy eye, resulting from an injury to or disease of the fellow-eye. The eye previously healthy is called the sympathizing eye; the eye first diseased is known as the exciting eye. Sympathetic irritation is said by some writers to be harmless so far as impairment of the function of the affected eye is concerned; others think that in rare cases sympathetic irritation passes over into sympathetic inflammation. The latter opinion is probably correct, but considerable time is required to bring about such a result, and both patients and physicians naturally take measures to forestall its occurrence.

The **symptoms** are—early fatigue of the eyes in reading or in fine work, photophobia, sluggish, slightly contracted pupil, and slight hyperæmia of the conjunctiva on moderate use of the eyes. The range of accommodation is usually shortened.

Sympathetic inflammation begins as an inflammation of some part of the uveal tract or of the optic nerve. It is classified as serous or plastic according to the character of the exudation, although the dividing-line between the two is not sharply marked. The onset of the disease is insidious, being often unaccompanied by pain. In the serous form minute flakes of exudation appear on the posterior surface of the cornea. The iris is hyperæmic, some posterior synechiæ form, and the vision is impaired. More or less exudation takes place within the anterior segment of the globe. In the milder cases the disease may be controlled or subside, leaving useful vision.

In the plastic form the onset is often as inconspicuous as in the serous variety, but at times is more acute and is accompanied by pain. The iris becomes greatly thickened. The pupillary area soon fills with exudation; exudation also appears in the vitreous. It occasionally happens that the part of the eye first affected is the optic papilla. A condition of mild neuritis or neuro-retinitis first exists, the participation of iris and ciliary body following. By filling up the lymph-channels at the iris-angle the escape of fluids from the interior of the eye may be partly cut off, and glaucomatous tension may result. Ciliary staphyloma may form as a result of increased tension. The disease runs its course in from six weeks to as many months, and destroys the eye. Sympathetic ophthalmia is excited by an eye in which irido-choroiditis of a chronic type has been set up.

The **cause** is usually traumatic, either accidental or from operations, and the variety of exciting pathological conditions is extremely great, but irido-choroiditis has been brought about. It is thought never to occur when the external tissues of the eye have not been penetrated. In almost all cases the exciting eye is found to be sensitive on pressure over the ciliary region, especially above, and in many cases has been the seat of more or less pain. The method of the communication of the inflammation is supposed by some to be by way of the ciliary nerves, and to be reflex in nature; however, in later years the belief in a bacterial origin has gained many adherents. The infectious principle is thought to find its way along the optic nerve and chiasm from the exciting to the

sympathizing eye; but this theory lacks satisfactory proof; neither have the specific bacteria been identified. The best summary of this extremely important and difficult subject is by Schirmer.[1]

Treatment.—Removal of the exciting cause in cases of sympathetic irritation is almost always followed by relief. In the early stage of the inflammatory form removal of the exciting eye is demanded; it is of doubtful value in cases where the disease is advanced, but does not aggravate the condition, and, if the exciting eye is sightless, should always be done. Enucleation is the operation usually chosen; however, removal of a section of the optic and ciliary nerve-trunks is sometimes practised. When the globe has been badly lacerated by an injury or a large or infectious foreign body has penetrated it, enucleation is done as a measure of prevention against sympathetic inflammation.

Enucleation of the Eyeball.—Ether or chloroform anæsthesia is necessary. Insert the speculum for separating the lids, lift the conjunctiva at the margin of the cornea with the fixation forceps, and, with a pair of blunt-pointed or moderately sharp-pointed scissors, curved on the the flat, dissect the conjunctiva from around the cornea. It is well to preserve as much of the conjunctiva as possible, in order to secure a sac capable of containing a good-sized artificial eye. The subconjunctival tissue in the vicinity of the insertion of a rectus muscle (upper to be preferred) is now divided, and a strabismus-hook is passed beneath the tendon of the muscle. The insertion of the tendon and the attachments of Tenon's capsule are divided under the hook, cutting close to the sclerotic. The hook is carried around the globe, and all the tissues anterior to the equator are divided. The globe, if not too large, may now be forced forward by pressing the blades of the speculum beneath it. Whether forced forward or not, the blunt-pointed enucleation scissors, which is curved on the flat, is pushed downward on the nasal aspect of the globe and the point moved upward and downward until the position of the nerve is ascertained; the blades are now opened and made to straddle the nerve, which is then cut. The globe may be grasped on its outer or inner aspect with the fixation forceps, and held while the nerve is being cut if desired. A sharp flow of blood usually follows the division of the vessels at the posterior part of the globe, making it desirable to complete the operation as soon as possible. Immediately after dividing the nerve the globe is pushed forward with the scissors, seized with the fingers, and the tendons of the remaining muscles, the obliques, with the remaining attachments of Tenon's capsule, divided. After the hemorrhage ceases the wound in the conjunctiva is closed with a running suture. A compress bandage should be applied to prevent subsequent hemorrhage.

Optico-ciliary Neurectomy.—This operation is resorted to in cases where enucleation is refused by the patient, and in some cases where a favorable cosmetic effect is desired. Although sympathetic inflammation may thus be favorably influenced, it has been known to occur in spite of the operation.

Operation.—An opening is made through the conjunctiva and subconjunctival tissue between the internal and superior recti muscles, dissecting backward to the optic nerve. The optic nerve is then caught on

[1] Graefe, *Archiv f. Ophth.*, xxxviii. 4, S. 95.

ll strabismus-hook and drawn forward: it is then divided as far
ard toward the apex of the orbit as possible, and the end of the
is drawn out of the wound. The short ciliary nerves are divided
back as possible, and these and the optic nerve cut away close to
lerotic. The globe is now pushed back into place and the wound
with sutures. A much easier way is to divide the tendon of the
internus muscles near the sclerotic, and to restore the muscle by
of sutures when finishing the operation. Sharp hemorrhage some-
accompanies the operation, and a firm compress bandage must be
d. Complete restoration to its place is not always possible at once,
ill gradually ensue.

ıe operation is also performed for the purpose of allaying pain in
obe.

ı operation sometimes resorted to in the place of enucleation is
ration of the globe. This is done in the following manner: The
tic is pierced in the horizontal meridian with a Graefe or Beer's
ct knife about 3 mm. back of the sclero-corneal margin, and the
or segment of the globe is excised. With a small curette the vit-
retina, and choroid are carefully removed, and the cavity washed
ith an antiseptic solution. The edges of the sclerotic and conjunc-
re brought together by sutures and a compress bandage applied.
nethod is employed in cases in which the posterior part of the eye
the seat of disease. Sympathetic ophthalmia and painful stumps
followed this operation. Exenteration may be more simply done
st dissecting away the conjunctiva, then open the eyeball by a free
erse incision, wipe out the interior thoroughly with a sponge dipped
iseptic solution and held by forceps, and close the wound by catgut
s.

ıe conjunctiva is united with silk sutures over the sclerotic.

Diseases of the Crystalline Lens.

.TARACT.—The condition of the crystalline lens that most fre-
ly calls for operative procedure consists of opacification of the
ıbstance or of the lens-capsule. Cataract may be classified as
s:

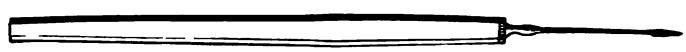
Congenital. . .	Posterior polar, Zonular or lamellar, Diffuse.
Cataracts occurring in early life.	Anterior polar, White or soft, Degenerated or calcareous, Complicated—black and yellow.
Senile cataract .	Cortical, Nuclear, Morgagnian, Sclerosed.
Secondary or membranous.	
Diabetic.	
Traumatic.	

Posterior polar cataract presents a limited opacity on the capsule at the posterior pole of the eye, or in the posterior part of the lens-substance, about the antero-posterior axis of the lens. Operative procedure is seldom employed in this variety.

Zonular or lamellar cataract consists in an opacification of a few lamellæ of the lens, usually situated about midway between the centre and the surface of the lens. This condition calls for operative procedure if the opacity is so dense that useful vision is interfered with. The operations resorted to are—1st, iridectomy for visual purposes; 2d, discission of the lens; 3d, extraction—(*a*) by suction; (*b*) by expression.

Discission.—The instruments required are as follows: Speculum, fixation forceps, stop-needle, knife-needle, or other suitable needle.

FIG. 105.



Straight cataract needle.

OPERATION.—Cocaine anæsthesia is sufficient. The patient is placed in the recumbent or in the sitting posture as best suits the operator, who

FIG. 106.

Knapp's knife-needle.

stands behind the patient's head. Good light is necessary. After the speculum is adjusted the eye is held steady with the fixation forceps.

FIG. 107.

Hayes's knife-needle.

The needle pierces the cornea on its temporal side, at a point midway between its apex and the periphery and slightly above the horizontal

FIG. 108.

Sickle-shaped iris knife.

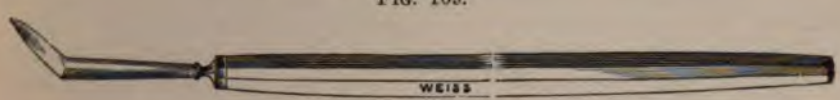
meridian. Pushed to the opposite side of the pupil and a little behind the iris, it is there plunged through the capsule of the lens, entering the lens to a slight depth, and by elevating the handle a horizontal incision is made through the capsule and the superficial layers of the lens. A vertical incision of the same depth and extent should next be made and the needle slowly withdrawn. Remove the speculum, instil a drop of a 1 per cent. solution of atropine and apply an aseptic bandage. The shank of the needle must fill the opening made by the blade to prevent escape of aqueous. Absorption of the lens-substance follows, but it

will be necessary to repeat the operation two or three times, going deeper into the lens-substance each time, before complete absorption takes place. The operation is comparatively safe. Six months to one year is required to bring about complete absorption.

The swelling of the lens-substance after needling, as after traumatism resulting in rupture of the lens-capsule, is sometimes so great that the tension is augmented and the eye becomes very painful: it is then necessary to evacuate the soft lens-matter from the eye by the linear operation.

Linear Operation.—The pupil is dilated with atropine, and cocaine anæsthesia is established. The speculum is inserted, and the globe fixed with the fixation forceps. An incision is made through the cornea at the temporal side, 1 to 2 mm. from the corneal margin and about 6 mm. long, with a broad needle, a keratome, or a Graefe knife.

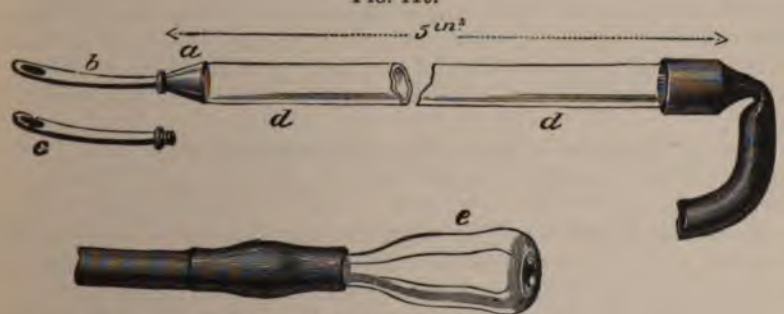
FIG. 109.



Narrow bent keratome.

If after the knife is withdrawn, the lens-substance does not escape readily by gentle pressure made over its nasal margin, it may be broken up by the cystitome (Fig. 113). If all of the lens-substance does not

FIG. 110.



Teal's suction apparatus for cataract.

escape, it may be cautiously coaxed out by a spoon (Fig. 112) pushed behind the fragments, or the anterior chamber may be irrigated with sterilized normal saline solution by means of Panas's syringe or other suitable appliance. If the iris prolapses with the gush of aqueous, it may be gently restored to the anterior chamber by means of the spatula, or, failing in this, a small bit may be excised.

The Suction Operation.—The soft lens-matter may be removed by means of a suction apparatus or aspirator.

OPERATION.—An incision is made (Fig. 116), as in the linear operation, sufficiently long to admit the nozzle of the aspirator. The lens-substance must have been brought to a semiliquid condition and the capsule freely opened. The nozzle of the aspirator is inserted

amid the lens-substance and gentle suction made, care being observed not to engage the iris or posterior capsule. The instrument must be handled gently, and be carefully sterilized before use. This proceeding has little to commend it above the simple linear operation.

Diffuse Congenital Cataract.—If operated on, it may be removed by the methods employed for the removal of zonular cataract.

Anterior Polar Cataract.—If very small, nothing need be done. If it is nearly the size of the pupil, a small iridectomy may be suitable.

White or Soft Cataract requires treatment by linear incision or by suction.

Degenerated and Complicated Cataract will be considered under the heads of Senile and Membranous Cataract.

The term "degenerated cataract" is often used synonymously with the term "calcareous cataract," and is employed to designate a lens which has shrunken and in which calcareous deposits have taken place.

A "complicated cataract" is a cataract that develops as a result of marked intraocular disease or accompanies grave lesions of the interior of the eye, as hemorrhage, detachment of the retina, extensive choroidal changes, or degeneration of the vitreous. The black and yellow cataracts are probably always complicated cataracts.

Senile Cataract, as the term implies, is a condition peculiar to old age. The terms incipient, immature, mature, and hypermature are employed to designate the different stages of development. When the cataract has not reached maturity, the cortical substance of the lens adheres closely to the lens-capsule, and is detached with much difficulty, making its expulsion in some cases a dangerous procedure. When the cataract is mature, the cortical substance is easily detached, and the lens escapes from the capsule with comparative ease. After a long duration the cortical layers degenerate, and may take on a fluid consistency, forming the so-called "Morgagnian cataract." The fluid is more or less opaque.

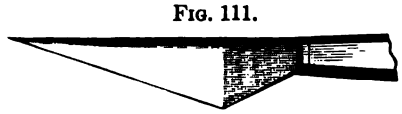
Diabetic Cataract is amenable to the same operative procedure employed for the removal of senile cataract, and ordinarily gives equally good results.

Traumatic Cataract may be removed, when operative interference is indicated, either by the needle operation, the linear operation, or rarely by the method employed for the removal of senile cataract.

INSTRUMENTS.—Specula and fixation forceps have been described.

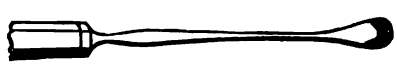
Knives.—Beer's triangular keratome or cataract knife is one type, and is used by some operators in a modified form. Schweigger uses a trian-

FIG. 111.



Beer's cataract knife.

FIG. 112.



Cataract spoon.

gular knife that measures 7 mm. at 30 mm. from the point. The long, narrow knife known as the Graefe knife is most generally employed, and is, on the whole, probably the most satisfactory.

Cystitome.—The Graefe cystitome (see Fig. 113) is the most useful

when the opening through the capsule is to be made at the centre of the pupil, or if in doing the simple operation the peripheral capsulotomy is preferred. If an iridectomy is made and peripheral capsulotomy is

FIG. 113.

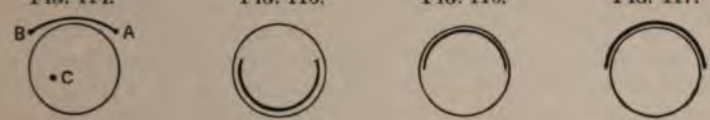
Cystitome.

practised, the writer prefers to use the straight cystitome devised by Knapp. In both instruments the edge should cut, not tear.

Iridectomy forceps and spatula have been described under instruments for iridectomy. A Daviel or Critchett's cataract scoop may be employed to exert pressure for the expulsion of the lens.

OPERATION.—The form of incision may be classed under two heads, the flap and the linear. A modification of the former is that most commonly used at the present day.

FIG. 114. FIG. 115. FIG. 116. FIG. 117.



At the present day the incision, whether flap or linear, is usually made a little above the horizontal meridian of the globe. Many make puncture and counter-puncture in the sclerotic about 1 millimetre from the clear margin of the cornea, and, making a flap incision that approaches the linear incision in form, complete it at the margin of the clear cornea or slightly within this margin. Many operators employ the Graefe knife. Daviel, Beer, and Liebreich performed the operation without iridectomy. Mooren, Von Graefe, and Von Graefe's followers perform iridectomy as an essential part of the operation. The operation without iridectomy is known as the simple operation, with iridectomy as the combined operation. The return to the simple operation was advocated by the French ophthalmologists, and is now probably more extensively practised than is the combined operation.

Iridectomy.—This part of the operation has been fully dwelt upon: it will suffice here to state that the iridectomy should be small. An iridectomy facilitates the escape of the lens and lens-cortex, but increases the bleeding and the risk of the escape of vitreous.

Cystotomy.—For the prevention of the formation of posterior synechiæ it is desirable to make a capsulotomy that will avoid the formation of numerous flaps. A straight incision through the capsule may accomplish this result. A capsulotomy near the periphery of the lens, parallel to the incision through the cornea, has been much advocated by Knapp, and is commonly practised by one of the writers (W.). It may be made either when iridectomy has or has not been performed. If iridectomy has been performed, the straight cystitome of Knapp may be employed; when iridectomy has not been performed, the Graefe cystitome should be used. The anterior insertion of the suspensory ligament must not be interfered with.

OPERATION.—*Right Eye.*—The patient should undress, be placed in the bed in which he is to remain, or on the operating table or in the operating chair, with the head in a position to enable the operator to work with ease. The surface of the lids and surrounding parts, which have previously been cleansed with soap and water, are again carefully washed, and subsequently bathed in an antiseptic solution, preferably sublimate, 1 : 5000. The roots of the lashes and the orifices of the Meibomian gland are carefully examined and cleansed. The lids are everted and their conjunctival surfaces are carefully cleansed with sublimate 1 : 5000 or with some indifferent solution that has been sterilized by boiling. A sterilized 4 per cent. solution of cocaine should be instilled three or four times before the operation is commenced, beginning about ten minutes before operation. Ambidextrous operators always place themselves behind the patient. Operators who must make the incision with the right hand stand on the left side of the patient when operating on the left eye. The speculum is placed in position. After the eye has been flooded by a rubber bulb with an antiseptic solution the fixation forceps seize the conjunctival tissue just below the margin of the cornea, in the perpendicular meridian, and the incision is made. The point of the knife penetrates the anterior chamber at the scleral margin, passing downward and inward toward the lower margin of the pupil; the handle of the knife is now deflected in such a manner that the counter-puncture can be made at a point corresponding to the point of puncture. By a long sweeping motion, exerting but little pressure on the corneal tissue, the knife is made to cut its way out, the section being terminated slowly, that the escape of aqueous may be slow and that no sudden strain may come upon the suspensory ligament of the lens. If an iridectomy is to be made, the fixation forceps are entrusted to an assistant. After the iridectomy the surgeon resumes control of the fixation forceps and takes the cystitome. This instrument is held as the Graefe knife is held. It is introduced through the centre of the corneal wound with point reversed, until it reaches the spot a little under the iris where the incision in the capsule is to begin. The cutting edge of the cystitome is turned against the capsule, and by a steady, slow movement the incision is made. It is now rotated, putting the back toward the wound, and is carefully removed. The fixation forceps are now removed. If the lens presents or if the patient is unruly, it is often best to remove the speculum at this stage. Should blood-clots obstruct the corneal wound they may be removed by a pledget of cotton wet in antiseptic fluid, or by forceps. With a Daviel's spoon in the right hand, with its back against the sclero-corneal margin below, and a spatula in the left hand in close proximity to the posterior lip of the wound, steady pressure is directed toward the centre of the globe to force the lens upward and tilt its margin forward to enter the wound. The direction of the pressure and its force are not to be changed until the bulk of the lens has passed through the wound. It is then relaxed, and the spoon follows up the lens, to force out as much cortex as possible. Any that remains will usually slip out by gently stroking the cornea two or three times upward with the spoon. There may be none visible in the pupil, but the inability to count fingers at six inches' distance indicates its presence, and if the patient be extremely quiet and docile one may throw a stream of sterilized normal

saline solution or a sterilized solution of boric acid upon the corneal wound, employing a simple bulb syringe (Noyes) or Panas' syringe or other irrigator. It will penetrate the anterior chamber and bring out the cortical matter. If the patient be quiet and easily controlled, the speculum need not be removed until the lens is expelled. If, however, he should be restless and disposed to "squeeze," one will remove the speculum before doing cystotomy or directly after doing it. Bid the patient look down and release the upper lid first; at the same time lift it away from the eye. The operator's finger or a small strabismus-hook will usually suffice to command the upper lid while further steps are being taken. Should the iris be prolapsed, a very small spatula will push it back, or it may return spontaneously. If iridectomy has been done, be careful to dislodge the iris from the extremities of the wound and secure a free pupil. The patient is now permitted to rest for a few minutes. If any shreds of capsule or blood-clots remain lying in the wound, they should be removed by a small pledget of wet cotton or by forceps and scissors: the eye is again irrigated with an antiseptic and a dry gauze bandage applied to both eyes. The patient remains quiet in bed for twenty-four to forty-eight hours after the operation, often for four days. The bandage is usually removed after twenty-four hours, atropine solution gr. iv ad ℥j is instilled, the edges of the lids are very gently wiped with warm sterilized boric-acid solution and the bandage is again applied. It is the writer's practice to release one eye on the fourth or fifth day, and to remove the bandage entirely on the eighth day; the patient may be kept in a room where the light is subdued by the use of suitable curtains, and may sit up on the third or fourth day. In operating on the left eye, with the operator standing behind the patient, the knife, iris forceps—if iridectomy is done—cystitome, and Daviel spoon should be used with the left hand, the fixation forceps and iris scissors with the right hand.

Membranous or Secondary Cataract.

The instruments required are—speculum, fixation forceps, and needles, which must have cutting edges, either on one side (Knapp, Hayes) or on both sides, and the shank must perfectly fit the corneal wound. The capsule may contain dense fibrous bands or it may be thick throughout, and for this condition one may use two needles introduced from opposite sides of the cornea. In other cases a Hayes knife-needle may be introduced through the sclera about 10 mm. behind the limbus corneæ to cut the pupillary membrane.

Operation of Discission.—The patient is placed in an operating chair or in the recumbent position on a table or bed, and the light from a gas-jet or bright lamp concentrated on the pupil by a large convex lens of about 8 inches focus and 4 inches diameter. No other light should be allowed to interfere with the field of work. Cocaine anæsthesia is employed; atropine has been instilled. The lids are held apart with a speculum and the eye fixed with the forceps, which should grasp conjunctiva and subconjunctival tissue at the margin of the cornea in the lower inner quadrant. The needle, held in the right hand if the right eye is being operated on (in the left if the left eye is being operated

on), enters the cornea rather obliquely and flatwise at a point midway between the apex and margin of the cornea near the horizontal meridian. Its point crosses the pupil to its opposite margin and pierces the capsule. By lifting the handle, and at the same time turning the edge backward and withdrawing a little, a cut is made horizontally; then another is made vertically by turning the blade suitably. To secure a cruciform incision it is better to cut from the circumference of the pupil toward its centre: the manœuvre is delicate. If tight bands cover the pupil, these must be avoided. After division the flaps separate and eventually retract, leaving a clear pupil. When two needles are used for a dense membrane, they are passed through its central part and caused to cut away from each other, and in so doing the handles as elevated may cross each other.

Operation by means of De Wecker's scissors has been described.

Ripening Immature Cataract.—Foerster of Breslau instituted the following method: An iridectomy is made as in the combined operation for cataract; after this is done a smooth strabismus-hook is passed over the cornea, pressing it against the lens. The hook is moved over the pupillary area, producing gentle massage of the lens. This proceeding is applicable to a limited number of cases in which the cortical layers of the lens are the first to opacify; complete opacification is reached in from two to six weeks. The lens is then ready to be extracted.

Foreign Bodies in the Vitreous.

Particles of iron or steel are most frequently the offending agents. They are often capable of removal by a magnet designed for this purpose. Its point is passed into the eye, either through the opening made by the foreign body or through a T-shaped opening made through the sclerotic between the insertion of the exterior and inferior recti muscles, about 8 mm. back of the sclero-corneal margin. If contact is effected with the particle of iron, it may be drawn to and through the external wound, but it is often necessary to seize it with forceps and complete its removal at the external opening.

Foreign bodies other than iron must be removed, if possible to be removed, by means of the forceps or foreign-body hook.

We are frequently compelled to enucleate the eye which contains a foreign body, either because of the severity of the reaction or because the opposite eye is liable to sympathetic trouble.

Cysticercus.—When this parasite is present in the eye, either the eye or the animal must be removed.

Operation.—A long equatorial incision is made through the sclerotic, usually in the lower outer quadrant of the globe anterior to the equator, and through the vitreous, up to the animal. The animal is then seized with forceps and drawn out. The operation may in some cases be watched through the pupil by the ophthalmoscope. As a general thing, eyes affected with entozoa must be enucleated sooner or later.

Strabismus.

Strabismus is a term used to designate failure of co-ordination in the visual lines. It may be classified as concomitant or paralytic. In con-

nt strabismus the excursion of the eyes is equal ; in paralytic, the ients of the affected eye are limited in the direction of the muscles scle paralyzed. Strabismus is said to be convergent when the eye inward, divergent when the eye turns outward, sursumvergent the eye turns upward, and deorsumvergent when the eye turns ard.

nditions of the extrinsic muscles, by which the relative strength n antagonistic pairs of muscles is not normal, are recognized and of as insufficiencies. Under these conditions binocular fixation ally maintained, but by an unusual effort, and the term "latent mus" is sometimes applied to such conditions.

e OPERATIONS employed for the correction of these anomalies of e-muscles have for their object the setting back or bringing for- f the insertions of these muscles, so that the power of rotation of obe is lessened or increased in the direction of the action of the that is operated on. The operations on the muscles are almost y confined to the recti muscles. The effect produced may be iely slight, as when only partial division of the tendon of the at its insertion is made (partial tenotomy), or it may be very con- le, as where the division of the entire tendon and of the lateral nents of Tenon's capsule, with advancement of the opponent, are

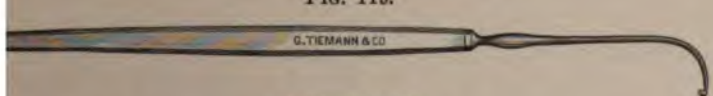
truments Necessary.—An eye speculum, fixation forceps, firm -tooth forceps which may be straight or curved, strabismus-hooks,

FIG. 118.

Mouse-tooth forceps.

bly small and with barbed tips (Theobald). Scissors: there are kinds; see illustrations. Stevens' scissors are to be preferred

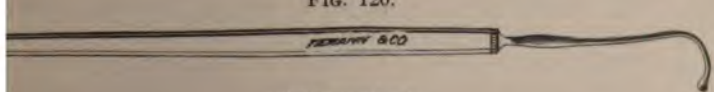
FIG. 119.



Strabismus-hook.

e of their small point and broad bearing. Strabismus-hooks: re of various sizes, having a hooked extremity of from 5 to

FIG. 120.



Strabismus-hook.

in length. The extremity may be straight, bulbous, or hooked.

Wecker's double strabismus-hook is employed by some surgeons in making advancements. (See Fig. 121.)

FIG. 121.

Wecker's double strabismus-hook.

The ordinary small full-curved needles are employed, with black iron-dyed silk for sutures.

FIG. 122.

Curved strabismus-scissors.

OPERATION.—*Partial Tenotomy.*—Cocaine anæsthesia: patient in the recumbent or sitting posture. Operator behind the patient if operating

FIG. 123.

Stevens' strabismus-scissors.

on the muscles of the left side of the eyes; at the left side of the patient if operating on the muscles of the right side of the eyes. The speculum is inserted, and the patient is directed to look toward the side opposite to that of the site of the operation. The end of the small mouse-toothed forceps is pressed against the conjunctiva over the insertion of the muscle, blades closed, and these permitted to spread to include about 2½ mm. of tissue; they are then closed, taking up conjunctiva and the insertion of the tendon; this mass is cut through with one snip of the scissors. The tendon is perforated, and the blade of Stevens' scissors is passed through and cuts the insertion above and below. A small strabismus-hook is next employed to reach the most lateral parts of the insertion, and these are carefully divided. A triangular piece of the centre of the tendon, having its base at the insertion of the tendon, may be removed if desired. (It is said to increase the effect of the partial

tenotomy.) A few fibres of the tendon at its borders are left undivided. A suture may be used to close the conjunctival opening. The effect of this operation is often *nil*, while an effect of from one to three degrees may be obtained. By continuing the detachment of the fibres of the tendon above and below a complete tenotomy may be done, which gives positive effects, and the result may be regulated by a suture. The writer's judgment is seldom in favor of partial tenotomy. Division of the natural attachments of Tenon's capsule increases the effect produced.

Open Method.—The procedure is as above, except that the wound is a little larger; but it must be remembered that incisions into Tenons' capsule will cause excessive effects on mobility as well as unpleasant sinking of the caruncle. A suture should be applied to the conjunctival wound.

Advancement of a muscle is done for paralytic strabismus and for extreme degrees of concomitant strabismus.

OPERATION.—Cocaine or ether anæsthesia may be employed. Besides the usual instruments, we need so-called half-round small needles whose points have been especially sharpened to pierce the sclera. Take two black silk threads and one white silk thread 10 inches long, and place a needle at each of their ends. Do an ordinary tenotomy upon the opponent muscle. Seizing the muscle at its insertion, make a vertical incision which reaches beyond the borders of the muscle. Separate it completely from the globe and lift the tissues. Take the end of the muscle and the conjunctiva in the grasp of a fixation forceps, and lay aside the forceps first used. By suitable needle-forceps pass the needle on the end of the white thread through the middle of the muscle from its deep surface at a point as far back as the effect to be obtained requires, and leave it in place. Next introduce the needles on the black threads, and these may go a little farther back. Now trim away the tissue lying in front of the needles and which is held by the forceps, and pull each needle through as it appears on the conjunctival surface. Separate the threads with care, lest they become entangled together. Pass the needle belonging to the other end of the white thread through the episcleral tissue, entering at 3 to 4 mm. from the cornea, and come out at the limbus. This thread will be the chief reliance. Pass the remaining needles in a a similar way, and let them come out at a little greater distance from the cornea—say 2 mm. Straighten out the threads. First tighten the middle thread by a double turn, then tighten the other threads. Draw each separately, and have them all equally effective; avoid twisting the globe in its vertical meridian. Finally, apply the last loop to each knot to hold it secure and cut the threads short. Trim away any projecting folds of conjunctiva, and use ordinary sutures as may be needful. Wash out the eye and apply a gauze bandage.

When only moderate effects are required, the sutures will go through the muscle nearer its insertion and less material will be removed.

TUMORS OF THE EYE.

Those met with are *sarcoma*, *glioma*, *syphilitic gummata*, *tubercular tumors*, and, extremely rarely, *myomata*. In all but the syphilitic tumors enucleation is the rule. We may do something by internal treatment to relieve symptoms due to gumma.

SURGERY OF THE EAR.

By GORHAM BACON, M. D.

organ of hearing is divided into three parts—viz. the external, and internal ears.

external ear consists of the auricle, or pinna, and the external audi-al (both cartilaginous and bony portions), extending as far as nbrana tympani, or drumhead, a distance of about one and a quar-es. The middle ear, or tympanum or tympanic cavity, is that por-tween the drumhead and the inner ear, and contains the trans- mechanism—viz. the drumhead and small bones, the malleus, nd stapes. The internal ear comprises the labyrinth, cochlea, tibule, with the membranous labyrinth, and receives the termi-of the auditory nerve.

auricle, or pinna, pyriform in shape, is attached to the side of l by ligaments and muscles. It is composed of yellow or reticu-rtilage, except the lower portion, which is called the lobule. The s formed mostly of connective tissue, and in its meshes are of fat. It contains a few blood-vessels and nerves. The carti-2 millimetres in thickness, is covered by the perichondrium, and to the perichondrium is the integument, which is more firmly l to the anterior surface of the cartilage than to the posterior.

external meatus, or auditory canal, consists of a cartilaginous ony portion. The cartilaginous, a continuation inward of the is not cartilaginous throughout e extent, the cartilage being want-he upper and posterior portion of al, where a membranous layer to the lining membrane of the kes its place. The fissures of i, generally two in number, are in the lower and anterior wall artilaginous meatus. These fis-e openings in the cartilage which d in by fibrous tissue. They mportance to the aurist from the t an inflammation of the exter-may extend to the parotid gland these fissures, and, *vice versa*, in parotiditis leading to the form-an abscess the pus may force its ugh these openings into the exter-tory canal and give rise to an otor-e diagnosis of which can only be ly determined by means of the head-mirror and speculum.

FIG. 124.

Auricle or pinna: *a*, helix; *b*, anti-helix; *c*, tragus; *d*, antitragus; *e*, lobule; *f*, concha; *g*, orifice of the external meatus.

The osseous canal, forming about two-thirds of the entire external meatus, consists simply of a bony ring in the infant (the annulus tympanicus), but which develops later in the adult into a bony canal about three-quarters of an inch in length. In the infant the tympanic ring is attached to the squamous portion of the temporal bone by its two extremities, between which is a space which later in life becomes the Rivinian segment. The cartilaginous canal contains soft hairs, and sebaceous and ceruminal glands, but a few of the latter are found in the bony portion, especially in its upper wall. The lining membrane of the cartilaginous portion is simply a continuation inward of the integument of the face, but is not a mucous membrane, as formerly supposed. The dermal layer in the bony canal is very thin and closely attached to the periosteum.

The drumhead, or membrana tympani, forms the external wall of the middle ear, and is found at the inner extremity of the bony auditory canal, lying almost in a horizontal position in the infant at birth, and gradually becoming more perpendicular in the adult. The membrana tympani receives the sound-waves from the external air and conducts them by means of the ossicular chain to the inner ear. The drumhead is placed obliquely with the long axis of the bony canal, so that the lower and anterior walls of the external meatus are longer than the upper and posterior walls, an important point to remember in the extraction of foreign bodies. The membrana tympani at its margin is attached to a groove in the bony auditory canal called the sulcus tympanicus, which belongs to the tympanic ring. At the Rivinian segment, previously mentioned, the drumhead is attached partly to the margo tympanicus and partly to the lining membrane of the bony auditory canal.

In making an examination with the speculum it must be remembered that the cartilaginous portion of the external meatus in its direction inward passes backward and upward, and the bony canal passes forward and downward, so that in introducing the speculum in order to get the best possible view of the drumhead the auricle should be pulled upward and backward.

FIG. 125.

External surface of the left membrana tympani, several times enlarged: *a*, short process of the malleus; *b*, inferior extremity of its handle (umbo); *c*, anterior portion; *d*, posterior portion of the membrana tympani; *e*, anterior fold; *f*, posterior fold of the membrana tympani; *g*, membrana Shrapnelli; *h*, long process of the incus shining through.

There are two folds, anterior and posterior, which are very important, for when the drumhead is drawn inward they stand out much more prominently. The membrana flaccida of Shrapnell consists of very delicate and loosely-arranged fibres of connective tissue, crossing each other irregularly and covered by a thin dermic layer, being much thinner than the other portions of the membrana tympani.

The membrana tympani consists of three layers—the external or dermic layer, the middle or fibrous, and the inner or mucous layer.

The superior wall of the tympanum is formed of a thin lamina of bone which separates it from the cranial cavity.

FIG. 126.

Section of bone showing the inner surface of the drumhead, the ossicles, and several of the mastoid cells: 1, head of malleus; 2, handle of the malleus; 3, membrana tympani; 4, tympanic attic; 5, mastoid cells; 6, body of incus; 7, short process of incus; 8, long process of incus; 9, groove for lateral sinus.

The internal surface of the membrana tympani, with the malleus and incus, is shown in Fig. 126.

The malleus consists of a head, a neck, a short process, and a long process or handle. The incus, composed of a body, a short and a long process, articulates with the head of the malleus. The stapes has a foot-plate which is attached to the foramen ovale, besides two crura and a head, the latter articulating with the long process of the incus.

The middle ear communicates with the nasopharynx by means of the Eustachian tube, which latter is partly bony and partly cartilaginous.

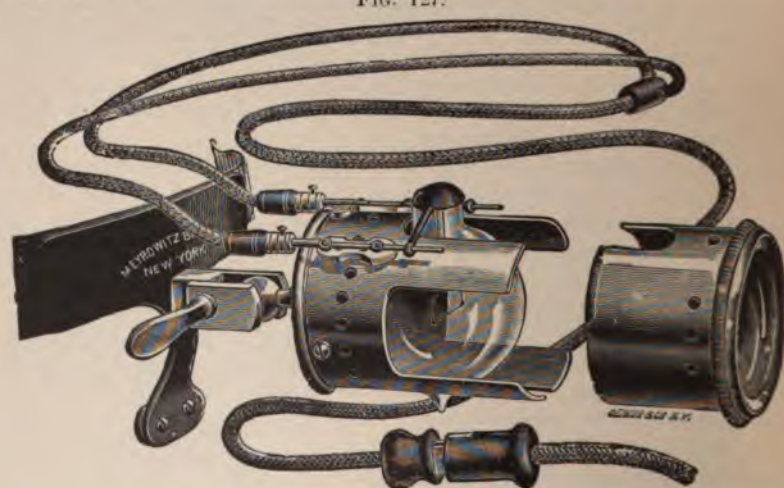
The canal for the musculus tensor tympani lies just above the bony Eustachian tube, and the muscle has its attachment by tendon to the inner surface of the malleus.

On the inner wall of the middle ear, besides the stapes and foramina ovale and rotundum, will be found the promontory, which corresponds to the first turn of the cochlea. The canal for the carotid artery is in close proximity to the anterior wall of the tympanum, while the lower wall is partly formed by the fossa jugularis. The mastoid antrum communicates above and posteriorly with the tympanum. The chorda tympani nerve passes between the malleus and incus, and the facial nerve enters the aquæductus Fallopii, and has its exit at the stylo-mastoid foramen. The position of the facial nerve, running first above and then behind the tympanum, is of especial importance to the aural surgeon, as it is occasionally injured in operations on the middle ear and mastoid cells.

The inner ear, or sound-perceiving apparatus, consists of the cochlea, semicircular canals, and vestibule, together with the membranous labyrinth and the expansion of the auditory nerves. The osseous semicircular canals are three in number—viz. the superior, the horizontal or external, and the posterior or inner—and contain the membranous semicircular canals. The vestibule contains the saccules, and the cochlea, its membranous portion, in which are found the organ or rods of Corti. The auditory nerve enters the internal auditory meatus together with the facial nerve, and divides into the vestibular and cochlear branches: the former enters the vestibule and supplies the utricle and the ampullæ of the membranous semicircular canals; the latter is distributed to the cochlea.

In order to make a thorough examination of the external auditory canal and membrana it is necessary to have good illumination. Daylight from a northern exposure is the most satisfactory. When this cannot be obtained gas-light must be substituted, and an argand burner or Mackenzie's bull's-eye reflector will give a good light. Some prefer the electric light, but for ordinary examinations gas is still the most practical and desirable. At night, and for certain operations to be mentioned later, we must make use of the electric light, and for this purpose I use Trouvé's "photophore eléctrique." Another excellent lamp is one lately devised by Leiter of Vienna, and also one made by Meyrowitz. (See Fig. 127.)

FIG. 127.



Electric lamp attached to head-band.

When brought to us for treatment, before an examination is made we should subject the patient to a most thorough questioning as to present symptoms, noting carefully as to the pain, the character of the discharge if present; as to whether there has been any vertigo or tinnitus; and, most important of all, as to any hereditary tendency to deafness. We should inquire as to the patient's general health, making note of any predisposition to catarrhal or other disease. We should then inspect the auricle and mastoid process. It is always well to compare both auricles

and both mastoid processes. It should not be forgotten that in some persons, generally those of an hysterical temperament, pain is complained of when firm pressure is made over the apex of the mastoid, so that it is always well to compare the two sides.

A very good head-mirror is the one recommended by Politzer and shown in Fig. 128. It is a concave mirror with an aperture in the

FIG. 128.

Concave mirror with head-band.

middle, and should be fastened to the forehead-band or metal spring by means of a ball-and-socket joint. The mirror is $2\frac{3}{4}$ inches in diameter, and has a focal distance of about 6 inches. In order to obtain the best view of the drumhead the mirror should be pulled down over the eye, so that the surgeon can look through the opening. Good daylight from

FIG. 129.

Brunton's otoscope: *a*, aperture containing a magnifying-glass; *b*, speculum—of these there are three sizes.

a northern window will give one the natural color of the drumhead. Direct sunlight is generally too dazzling.

Brunton's otoscope is but little used in this country, but is more

popular in England. Its advantages, as claimed by the inventor, are its simple construction, its easy application; it can be used with either sunlight or artificial light, and with or without the magnifying-glass (Fig. 129). The rays of light enter the funnel. Field of London uses a Brunton otoscope fitted up with an incandescent electric lamp and illu-

FIG. 130.

Brunton's otoscope, with electric lamp attached.

minated by a small portable battery (see Fig. 130). Brunton's otoscope is obviously useless except for purposes of diagnosis.

When good daylight cannot be obtained, an ordinary argand burner, with or without a Mackenzie's bull's-eye condenser, will afford the best light. The objection to the photophore for general use is that it becomes very hot when worn on a band around the head for any length of time.

The speculum that I generally prefer is the one known as Gruber's, which is made of silver and shown in Fig. 131. There are four sizes.

FIG. 131.

Gruber's speculum.

FIG. 132.

Politzer's speculum.

Politzer's specula of hard rubber are also excellent ones, and will be found especially useful when caustic applications are to be made to the canal or drumhead. They have the advantage of lightness (Fig. 132).

When making an examination it is of the greatest importance to have the patient in a good position. The ear to be examined must be away from the light, and the rays of light, striking the head-mirror at an angle of 45°, must be reflected into the external auditory canal. The speculum

should be warmed before introduction, and should not be pushed too far in, as pressure on the bony canal is quite painful. The canal should be straightened by pulling the auricle outward, upward, and backward. All parts of the canal and drumhead should be inspected, and any scales, cerumen, purulent or cheesy matter removed by syringing or with curettes or forceps, as the case may be.

FIG. 133.

Bacon's curette forceps.

All drops and solutions used in the ear should be warmed first, as cold is liable to cause vertigo and inflammation.

Forceps and curettes should never be used by the inexperienced, nor in cases except where there is an excellent illumination. The curette forceps (Fig. 133) I have used for many years, and find them especially adapted to removing hardened cerumen when syringing alone has failed.

The normal color of the drum-membrane, when examined with natural daylight, is of a pearly-gray color with a slightly bluish tint, while gaslight gives it a reddish-yellow color.

In looking at a drumhead one must note particularly (1) its color, whether normal or congested or opaque, whether atrophic, or whether it contains opacities and chalky deposits. (2) The position of the membrane, whether bulging, owing to a collection of fluid, or whether retracted. In the latter case the handle of the malleus, being retracted, will appear foreshortened; the short process will become more prominent, as well as the anterior and posterior folds, and the cone of light will be distorted.

The cone or pyramid of light, as shown in Figs. 134, 135, extends from the umbo almost to the lower periphery of the drumhead, with the apex

FIG. 134.

Normal Membrana tympani of the right ear.

FIG. 135.

Normal membrana tympani of the left ear.

at the umbo, and is supposed to be due partly to the convexity of the membrana tympani and to the angle that the drumhead forms with the long axis of the canal, and partly to its glistening or reflecting surface. To decide as to the mobility of the drumhead, and whether bound down by adhesions, more or less can be determined by touching the different parts with a probe. An instrument has been devised for this purpose—viz. Siegle's pneumatic speculum, which consists of a speculum with its

wide extremity closed by an obliquely-placed thin plate of glass, so as to make it air-tight when inserted in the external auditory canal. There is a small opening on the side, connected by rubber tubing with a Politzer bag, or, better still, with the masseur of Delstauche (Fig. 136). It is well to cover the end of the speculum introduced into the meatus with a small piece of rubber tubing, to make it fit accurately. I have modified this instrument by substituting the metallic Gruber specula for the hard-rubber ones, which are, as a rule, attached to this instrument.

FIG. 136.

Siegle's pneumatic speculum, with Delstauche's masseur attached.

To test the hearing distance of a patient the watch is most commonly used. The distance heard by a normal ear is first determined, and found to be, for example, 56 inches. This number will represent the denominator, and if a patient hears the watch at 10 or 12 inches, his hearing-distance should be recorded as being $\frac{10}{56}$ or $\frac{20}{56}$ inches. This method was first suggested by Dr. J. S. Prout of Brooklyn.

The patient's good ear should be carefully stopped by inserting the index finger in the meatus; then the watch should be held at the normal distance from the ear, and gradually brought toward it. The patient should also be instructed to close his eyes.

Politzer's acoumeter (Fig. 137) heard by the normal ear at a distance of 15 metres is useful when there is more or less deafness. The surgeon should also note as to whether the patient hears an ordinary voice or loud or shouting voice or the whisper, and the distance of the same from the ear.

FIG. 137.

Politzer's acoumeter.

By means of the tuning-fork a diagnosis can usually be made between diseases of the middle and internal ear. In a normal case the tuning-fork, when vibrating and held close to the ear, will be heard more distinctly and louder than when placed against the mastoid process or on the side of the skull. In other words, the aërial conduction will be louder than the bony conduction. Consequently, in diseases involving the external meatus or middle ear the sound will be intensified on the affected side when the tuning-fork is placed against the mastoid process or on the top of the head or against the teeth. We thus exclude diseases of the internal ear. In a case of deafness, when it is found that a patient hears the tuning-fork better by the air than by the bone, it is fair to assume implication of the sound-perceiving apparatus and when bone-conduction is lost it is certain that labyrinthine disease exists. For ordinary purposes a single fork, C_2, 528 vibrations, is an excellent one, or, better still, the tuning-fork of

Blake, 512, v. s. (See Fig. 138.) It should have clamps fastened to both extremities to prevent the overtones. For more accurate testing the five forks of Politzer, or Bezold's or Hartmann's forks, are to be preferred; also Galton's whistle and König's rods. A variety of tests with the tuning-fork has been proposed by Rinné, Gellé, Weber, Blake, and many others.

Fig. 138.

Blake's tuning-fork.

It is of the highest importance to determine the permeability of the Eustachian tube. This can be accomplished by the Valsalvian method, by Politzer's method, or by catheterization, the latter being most satisfactory when practicable. By the Valsalvian method the patient holds the nose closed with the fingers, and the mouth being also closed, the condensed air in the nasopharynx is forced through the Eustachian tube into the tympanum when the patient makes a forced expiration. This method is only useful in cases where we wish to make a diagnosis of the permeability of the Eustachian tube and to determine the degree of mobility of the membrane. The drumhead should be inspected under good illumination whenever this method is employed, but the latter must never be recommended to patients, as it tends to produce congestion of the head, and when frequently practised and for a long period is likely to stretch the ligaments of the ossicles and thus cause a relaxed condition of the parts.

Politzer's method is best described in his own words, as follows: "The patient, seated in a chair, takes a little water into his mouth, which he is required to swallow when told. The surgeon, standing on the patient's right, introduces the nozzle of the Politzer bag (see Fig. 139) 1 cm. into the corresponding orifice, and then compresses with the left thumb and fore finger the ala of the nose closely around the instrument. The patient is next told to perform an act of swallowing, and at the same moment the surgeon expels the air from the inflating bag with his right hand. By the condensation of air produced in the nasopharynx in this manner the closure effected by the soft palate is forced open, and its vibrations give rise to a dull, gurgling sound, which frequently, if not always, may be taken as an indication that the air has entered into the middle ear. The majority of the patients experience at the same time the subjective sensation of a stream of air entering both tympanic cavities."

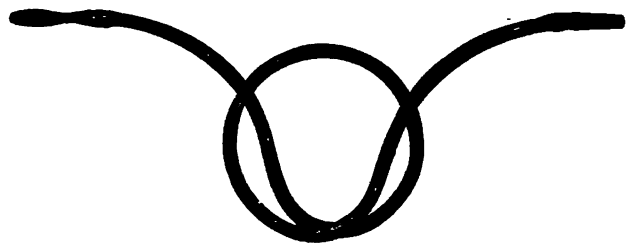
Fig. 139.

Politzer bag.

A diagnostic tube, shown in Fig. 140, consists of rubber tubing with a hard-rubber tip at either end for insertion into the surgeon's and patient's ears, so that the former can be certain that air enters the tympanum. The bag or balloon for inflating the ear should be pyriform in

shape, about the size of the double fist, and should have a curved hard-rubber tube or nozzle attached for introduction into the nose. I prefer, however, a glass nozzle made large enough to fill completely the meatus.

FIG. 140.



Diagnostic or auscultation tube.

METHOD OF CATHETERIZATION.—Both hard-rubber and silver catheters are ordinarily used. I prefer, however, the latter (Fig. 141), which

FIG. 141.

Blake's Eustachian catheter.

should be of four different sizes, while each should have a probe-pointed extremity for introduction into the nose. There are two methods generally employed for the passing of a catheter:

First Method.—The patient should be seated opposite the surgeon, and the former's head should be steadied by an assistant or allowed to rest against the back of a chair. The surgeon, either standing or sitting opposite the patient, should place the fingers of the left hand on the patient's forehead, gently pushing upward with the thumb of the same hand the extremity of the nose. With the catheter held in the right hand, the probe-pointed end is introduced very carefully after being warmed and smeared with ol. olivæ or vaseline. In a good many cases it is necessary to apply a 4 per cent. solution of cocaine to the nasal passages with an atomizer. The end of the catheter should be pushed along the lower wall of the nasal passage until it touches the posterior wall of the pharynx. The point of the catheter is then turned obliquely outward, but not enough to be in a horizontal position. It is then withdrawn, so that the point will be felt to glide over the projecting posterior tip of the Eustachian tube. The point is then turned still farther outward and upward, "so that the metal ring fastened to its posterior extremity is pointed toward the outer canthus of the eye of the same side. The direction of the beak corresponds, as a rule, with the axis of the Eustachian tube" (Politzer). The catheter can be held in position by the surgeon, or for this purpose various clamps have been devised by Bonnafont, Kramer, Delstauche, and others.

Second Method.—In this method the posterior margin of the nasal septum serves as a guide. The catheter is introduced in the same way as in the first method until the point reaches the posterior pharyngeal

wall. Instead of turning the point outward, it should be turned inward, so that the extremity points toward the other Eustachian orifice. It is brought to a horizontal position, as determined by the metallic ring on the other end of the catheter. The catheter is then withdrawn until the curved portion reaches the posterior border of the nasal septum. The point of the catheter is now made to describe a complete semicircle by moving its point downward along the velum palati and then outward. It should thus enter the pharyngeal orifice, and be inserted afterward in the tube in the same manner as in the first method. Any action of the muscles of these parts that pushes the point of the catheter backward or throws it out of position will interfere with the success of this method.

Before introducing the catheter the external extremity should have attached to it a piece of rubber tubing which is connected with a Politzer bag. The latter should have an opening on the side which can be closed by the thumb of the surgeon when forcing air through the catheter, so that it will be possible for air to enter the bag again without the necessity of disconnecting the tip of the Politzer bag after each compression of the bag.

I generally prefer catheterization to the inflation of the ear by Politzer's method in all cases wherever practicable, as it accomplishes much more when carefully performed, and the air enters more directly into the middle ear. By dropping volatile fluids through the opening in the Politzer bag vapors can be applied directly to the Eustachian tube and middle ear.

The obstacles to the introduction of the catheter are various pathological processes that involve the nasal passages, such as hypertrophic catarrh, polypi, adenoid growths, and congenital deformities of the nasal septum and spongy bones, etc. In acute inflammations of the middle ear with swelling of the orifice of the Eustachian tube catheterization is difficult and painful, as well as in some individuals where its accomplishment is prevented by spasmodic coughing and vomiting. In children it is also non-advisable. Where catheterization is impossible, owing to constriction of the nasal passages, air has been forced into the middle ear by the introduction of a catheter through the opposite nasal passage. Various catheters have been devised for this purpose, but the method was first advocated by Deleau in 1827.

The diagnostic tube should be used, as in Politzer's method, to determine the permeability of the Eustachian tube, for we cannot rely on the statement of the patient.

Diseases of the Auricle.

1. Malformations.—Malformations of the organ of hearing may exist alone or be associated with malformations of other organs, such as want of development of the eye or side of the face on the same side. There may be congenital excessive development of the auricle, the development of two auricles (polyotia) or so-called auricular appendages. According to Cassells, excessive development is usually limited to the auricle itself, while want of development is apt to occur with defect of development of the external meatus and tympanum, less frequently with defect of the internal ear. There may be entire absence of the auricle, a

malformation or absence of the different portions of the ear—viz. the lobule, helix, and antihelix. Imperfect development (microtia) is more frequent. The auricle is generally out of place in such cases, and may resemble a cat's ear, while the lobule is at times adherent to the skin.

I have reported[1] a case of malformation of the ear, with a plastic operation for the cure of the deformity. (See Figs. 140, 141.) The patient, a girl of fourteen, was seen Oct. 14, 1889. The attachment of the auricle was somewhat higher than the normal one. The auricle was small in size, while the external meatus was narrow and the drumhead not fully developed. The hearing-distance was but $\frac{1}{5}\frac{5}{6}$ on the affected side. Under ether I removed an elliptical portion of the integument and connective tissue, three-quarters of an inch in width and two and a quarter inches long, from the posterior and upper portion of the auricle, commencing the incision at the beginning of the helix and carrying it along the fold at the attachment of the auricle almost to the lobule, so as to leave as little scar as possible. The integument and connective tissue having been dissected away, the cartilage was bent back on itself, but not divided, and the different folds and depressions on the auricle were brought out by so doing. On Nov. 9th she was able to go home, the result being excellent, as shown in Figs. 142, 143. The hearing-distance was also

FIG. 142.

FIG. 143.

improved. She was advised to keep a pad with an elastic band over the ear for a short time.

Atresia or stenosis of the external meatus has also been occasionally observed.

All the congenital deformities are, according to Virchow, due to early disturbances in the closure of the first branchial cleft, and are often associated with cleft palate and other forms of arrest of development in the facial bones. I recently had under observation a case of fistula auris congenita.

[1] *Archives of Otology*, vol. xix., No. 1, 1890.

mmation, followed by sloughing of half of the lobule on each side.

3. Hæmatoma Auris, or Othæmatoma.—This is a swelling, of a sh color, due to a sudden effusion of blood between the cartilage and chondrium. The cause is usually due to a blow on the ear, and is requent occurrence among boxers. This affection is at times observed ng the insane, and was formerly supposed in such instances to be to ill-treatment. This may have been the cause in some cases, but more probable that the effusion is occasioned by tissue-changes in auricle itself. By severing the restiform body Brown-Séquard was to produce a hemorrhage in the auricle in animals.

The swelling, when seen immediately after the occurrence, is of a sh-red color, of a roundish shape, somewhat hard, but with no dis- t point of fluctuation. In some instances it is quite soft to the h.

Othæmatoma, occurring spontaneously, is rarely of large size, while ases due to traumatism the swelling may involve the entire auricle, ading both surfaces, and occlude the external meatus, thus producing siderable deafness. As a rule the swelling involves the concha and a of the helix and antihelix, but not the lobule. In the traumatic ety there is apt to be considerable pain, heat, and more or less ten- . The deformity depends very much on the extent of the hemor- ge and the injury to the cartilage.

Othæmatoma is differentiated from perichondritis auriculæ by the that it occurs suddenly and is usually caused by a blow.

As to **treatment**, some advise the application of cooling lotions, such he lead-and-opium wash. Where the swelling is slight, in some s it may disappear under such treatment. I have found it best, ever, especially where there is much swelling, to open the tumor at and treat it according to the usual surgical methods. A case seen a t time ago was freely incised and the clots and fluid blood evacuated; rward the cavity was washed out with a bichloride solution and the nd closed by sutures except at the lowest point, where a small tent doform gauze was inserted, and then a pad and bandage applied, the result of but little if any deformity. Massage is to be recom- ded in some cases.

thick yellowish fluid, less frequently with pus, and only occasionally are observed a few red blood-corpuscles. The perichondrium becomes detached from the cartilage, and the latter and the surrounding parts are greatly inflamed, leading subsequently to more or less thickening and disfigurement of the auricle. If an incision be made in the tumor and a probe introduced, the cartilage will be found denuded of bone and roughened. The inflammation may have its starting-point in the external meatus, and, as a rule, involves the concha and fossa helicis, but does not extend to the lobule.

Perichondritis is to be distinguished from hæmatoma by its more severe inflammatory symptoms, by its gradual development, and by the contents of the swelling being either of a clear, thick fluid or of pus, while in othæmatoma we always have blood at first. In the later stages, however, it is difficult to discriminate between the two, as an othæmatoma may also contain a clear syrupy fluid or pus, or even blood. As a rule, the resulting deformity is quite marked in cases of perichondritis, although in some few cases it may be but slight. The duration of the disease varies from two to ten weeks.

In the early stage the treatment should be entirely antiphlogistic, and the tumor incised as soon as fluctuation is detected. In opening the tumor and in all subsequent treatment antiseptic solutions should be employed. A pressure bandage and massage will be found beneficial in the after-treatment.

5. Cysts.—Under this heading Hartmann has reported[1] cases in which the tumors in the auricle had developed without any apparent signs of inflammation. One had existed three weeks at the time an incision was made in it, and the other two weeks. The contents of both consisted of a clear fluid without any flocculi or blood-corpuscles. As for the relation between cysts and perichondritis, Hartmann says "that inflammatory phenomena are altogether absent in the case of cysts, whilst perichondritis is accompanied with redness, heat, and severe pain. The contents of the swelling in perichondritis are similar to that in cysts, yet the fluid has an unclean, purulent character from the admixture of pus-corpuscles." Fischer, and later Virchow, Meyer, Pareidt, and others, have found in the aural cartilages, especially of the dyscrasic and insane, as also in the aged, certain changes which predispose to the formation of sanguineous tumors. Hartmann further says "that for the development of a cyst all that is necessary is a more abundant secretion of fluid, and for hæmatoma the traumatic influence, causing injury to the vessels;" and he believes that the processes of softening, etc. described by Fischer and others are not only the predisposing causes of hæmatoma, but are also to be regarded as a preliminary stage of simple cyst-formation. Cases of hæmatoma due to injury undoubtedly occur where there are no changes in the cartilage.

6. Ossification of the Auricle, in consequence of perichondritis sero-purulenta, has been reported by Knapp.[2] The portion removed showed the existence of real bone-substance, compact in some places, cancellous in others, and osteoid at the margins. Deposition of the urates is noticed occasionally in the auricles of gouty subjects.

7. Tumors of the Auricle.—Under this heading may be men-

[1] *Archiv. of Otology*, vol. xx., Nos. 2 and 3. [2] *Arch. of Otol.*, vol. xix. 45–50.

tioned dermoid cysts, warts, abscess, atheroma, papilloma, angioma, lipoma, fibroma, myxo-fibroma, aneurysmal dilatation of arteries, nævus maternus, malignant growths (including sarcoma, fibro-sarcoma, and more especially epithelioma). Buck has reported a case of cornu cutaneum which he removed with the knife.

Atheroma is developed from a blocking up of sebaceous follicles, and is more frequently found just behind and close to the lobule, in the integument, or in the lobule itself. The growth should be removed entire with the sac. When the sac cannot be dissected out, the cavity should be curetted so as to remove every trace of the sac and any purulent or cheesy matter.

Cases of fibroma are observed at times, the growth, as a rule, involving the lobule. The disease may affect both lobules, and is said to be due to piercing the ears, and is found quite frequently in the case of negro women. A fibroma is made up of fibrous connective tissue, with an occasional admixture of mucous tissue; it is of a round or globular shape, somewhat movable, and of more or less firm consistency. After total removal the growth is not apt to recur. I reported[1] a case of fibroma affecting the lobule of each auricle in the person of a young lady aged seventeen, who had had her ears pierced four years previously, and directly afterward the lobules began to enlarge.

The other growths sometimes noticed in the auricle, and before mentioned, should be excised if possible and treated on general surgical principles. Among the less frequent tumors that are occasionally observed may be mentioned cylindroma or myxoma cartilagineum, originating in the cartilaginous meatus; and enchondroma, having its origin from the cartilaginous portion of the external auditory canal.

8. Syphilitic Diseases.—Chancre and gummy tumors have been found on the auricle, but very infrequently. Tubercular syphilides on the auricle have been reported, and these may lead to deep ulcerations. Papular, pustular, and squamous eruptions are observed at times, but usually in connection with similar eruptions about the scalp and forehead.

Besides constitutional treatment, the application of iodoform to ulcerations and gummata is to be recommended.

9. Frost-bite.—If the auricle be actually frozen, the ear becomes very white, and in extreme cases may be brittle. To restore the circulation in the parts the patient should remain in a cool room and apply friction, very gently at first, to the auricle with snow, and afterward with cold water. After the re-establishment of the circulation warmer water may be used. In favorable cases the circulation becomes re-established, but the auricle is apt to be sensitive for some time afterward to the effects of cold. Frequently some portions of the auricle remain red for some time afterward. Where the auricle has been frozen and proper treatment has not been carried out, there may result severe inflammation, such as perichondritis, leading ultimately to gangrene. In the latter case amputation becomes necessary. Redness and burning of the auricle resulting from frost-bite should be treated with cooling washes, such as the liq. plumbi et opii.

10. Cutaneous Diseases.—*Eczema, Acute and Chronic.*—Eczema

[1] "Tumors of the Auricle," *Annals of Ophthal. and Otol.*, vol. ii., No. 3, 1893.

affecting the auricle is very similar to the disease occurring elsewhere, except that the hearing may be affected, especially when the auditory canal and membrana tympani are involved. The varieties are the erythematous, vesicular, pustular, and squamous. The disease may be acute or chronic, although the former is the more usual; it may attack all ages and sexes, but is more frequent among children and females. Eczema occurring about the pinna may be idiopathic or secondary to that occurring about the head or face. In the acute idiopathic form one or both auricles may be attacked, or the disease may be limited to one side. The auditory canal may or may not be involved. In the acute stage the ears are usually swollen, the seat of much burning and itching, covered by vesicles or pustules, which may become dry and thus envelop the auricle with unsightly crusts. The auricle in consequence becomes deformed and unshapely; the meatus may be closed by the collection of crusts or swelling of the parts, and as a result the hearing becomes impaired. A sense of fulness and tinnitus are often complained of. Painful rhagadæ may be found behind the ear. In chronic cases the auricle may be considerably thickened, leading to deformity and stenosis of the external meatus.

In children eczema is often caused by uncleanliness, picking at the ear, by unsuitable head-coverings, the ears being pressed against the head and causing an eczema intertrigo by the friction of the surfaces. Anything which tends to impair the general health, such as dentition, will act as an exciting cause. Other causes are the instillation of improper drops, an excoriating discharge from the middle ear, the effects of heat and cold, and, especially in children, pediculi about the head.

In acute eczema I have seen good results follow the administration of the fluid extract of viola tricolor. The urine should be examined for albumin or sugar. Diuretics and alkaline waters are required for those of a gouty or rheumatic diathesis. In scrofulous children cod-liver oil, syr. ferri iodid., and the hypophosphites should be prescribed. In chronic eczema Fowler's solution of arsenic should be given. Naso-pharyngeal catarrh or middle-ear disease should be treated, and any dental irritation should be removed. As to local treatment, in acute cases, the unguentium zinci oxidi will be useful or the ung. diachyli of Hebra. When the canal is involved the scales must be removed, and the same ointment applied by means of cotton on the end of a probe, or a powder containing equal parts of zinc oxide and boracic acid should be insufflated. No water should be used to remove the scales and crusts. In chronic cases I generally prefer the following: ℞ Acid. tannic., ʒj; vaseline, ʒj.—M. In dry and scaly eczema, attended with itching, an ointment containing tar should be used.

Hyperæmia.—This is observed in some cases as a result of frost-bite or eczema, also in patients suffering from valvular disease of the heart. The application of poultices may also produce a hyperæmic condition and lead to the formation of small abscesses. Cooling lotions, such as the lead-and-opium wash, are to be recommended in such cases.

Erysipelas.—Erysipelas, when appearing on the auricle, is apt to be developed in patients whose general health is not very good, and who have undergone some operation about the auricle or auditory meatus.

It may also occur in connection with facial erysipelas. I have reported[1] two cases of facial erysipelas occurring as a complication of disease of the ear. Leech-bites sometimes cause erysipelas, and the latter disease has been known to extend from the pharynx through the Eustachian tube and middle-ear and external meatus. In treating this disease I have seen good results follow the administration of drop-doses of tincture of aconite and tincture of belladonna. For a local application there is nothing better than the lead-and-opium wash.

The following skin diseases are also observed at times on the auricle, associated with the same disease elsewhere on the body—viz. herpes zoster, lupus, erythema, prurigo contagiosa, keloid, molluscum fibrosum, tinea tonsurans—for the treatment of which the reader is referred to standard works on dermatology.

Diseases of the External Auditory Canal.

1. Acute Diffuse Inflammation of the External Auditory Canal, *or Otitis Externa Diffusa Acuta*.—This may occur as a result of the instillation of improper drops in the ear. In one case under my observation "St. Jacob's Oil" caused acute inflammation of the external meatus, as well as of the middle ear. Injuries to the canal from the introduction of hair-pins and other such instruments to relieve itching frequently cause diffuse inflammation. As an idiopathic disease I believe this affection to be extremely infrequent, although cases do occur, followed by suppuration, when the middle ear is not involved. Diffuse inflammation of the canal is of common occurrence in connection with middle-ear suppuration when the discharge is acrid, and also in connection with furuncular inflammation of the meatus. In the early stage the meatus is greatly congested, more markedly about the bony portion. The cartilaginous portion may be so swollen that but little of the bony portion can be seen. The canal becomes very narrow from the swelling; the dermal layer, white and sodden from a serous discharge, peels off, leaving the canal and drumhead extremely red and excoriated. The hearing is affected when the canal becomes very much narrowed. Other symptoms are radiating pains, especially when moving the jaw and when making pressure about the ear. Sometimes there is tinnitus and dizziness. Itching of the canal very often precedes the inflammation. The latter may disappear in a few days or continue for a week or two, or eventually become chronic.

As to treatment, when the inflammation and pain are not severe drops of liq. morphiæ sulphat. (℥j, aquæ ℥j) or atrophiæ sulphat., 1 grain to the ounce, should be instilled warm in the ear. Very often a saturated solution of boracic acid, when used frequently, will relieve the pain. When the inflammation is severe the artificial leech (to be described subsequently under Middle-ear Inflammation) must be applied. When the canal is very narrow from swelling, free incisions should be made through the skin and periosteum. After the subsiding of the acute symptoms, especially if there be much discharge, and after removing pus and scales by curettes and syringing, powders containing equal parts of boracic acid and zinc oxide, or boracic acid alone, should be insuf-

[1] *Arch. of Otol.*, vol. xvi., No. 2, 1887.

flated. The general health of the patient should be attended to, as this disease is liable to occur among those somewhat debilitated.

In the chronic form of diffuse inflammation, besides the powders just mentioned, it may be necessary to use drops of alcohol, either pure or diluted one-half, and containing boracic acid (20 grs.–℥j).

Ulcerations and polypi may result as a consequence of the inflammation, and should be treated in the usual way.

2. Otitis Externa Hæmorrhagica.—Hemorrhagic vesicles make their appearance in a few cases on the walls of the bony auditory canal, and sometimes extend to the membrana tympani, covering a portion of the latter. These vesicles constitute a disease[1] per se, although they are also observed in the course of an acute inflammation of the middle ear. The vesicles are dark-bluish in color, and, when punctured, blood escapes. The disease reaches its height about the third day. The vesicles should be punctured and boracic-acid powder insufflated.

3. Croupous Inflammation.—This is a rare disease, in which the meatus and drumhead may be covered by a layer of lymph similar to that found in croup occurring in the larynx. It is generally observed as occurring secondary to an otitis media.

The prognosis is favorable. The false membrane should be removed by syringing and forceps, and boracic-acid powder must be blown into the meatus.

4. Diphtheritic Inflammation of the external auditory canal is most frequently associated with diphtheria of the nasopharynx and middle ear. Primary diphtheritis of the meatus has been described by some writers as developing during an epidemic of that disease in a canal previously excoriated from diffuse inflammation. The exudation, of a dirty-gray color, when removed leaves an excoriated and bleeding surface.

Diphtheria of the middle ear may lead to serious complications, such as necrosis and loss of the ossicles, necrosis of the tympanum and external bony meatus. Great deafness from secondary involvement of the labyrinth may follow.

Besides constitutional treatment, the ear should be frequently syringed with a bichloride solution (1 : 5000), and all scales removed with forceps. Afterward iodoform and boracic-acid powders should be insufflated.

5. Syphilis.—Syphilitic affections in the canal are, as a rule, confined to condylomata and ulcers, which occur in connection with general syphilis.

6. Otomycosis.—This is a name given to a parasitic inflammation of the auditory canal. Aspergillus niger is the fungus most commonly observed. Other varieties are the aspergillus flavus and aspergillus fumigatus. The disease is said to be frequent among the Russians who live in poorly-ventilated and damp houses, dampness being favorable to the growth of the fungus. There is apt to be a sense of fulness in the ear, with tinnitus and impairment of hearing. There may be some pain. When inspected, the canal usually contains scales, which may be mistaken for epidermis or cerumen. Most frequently the canal has the appearance of being covered with fine coal-dust, after the removal of which the canal is excoriated. There is little if any discharge of pus.

[1] "Otitis Externa Hæmorrhagica," *Arch. of Otol.*, vol. xix., No. 1, 1890.

After removing the scales, the instillation of alcohol or of a bichloride-of-mercury solution (1 : 5000) will prevent the growth of the fungus.

7. Furunculosis, or *Acute Circumscribed Inflammation of the External Auditory Canal*, or *Otitis Externa Circumscripta Acuta*.—This is a very common complaint, especially among the broken-down in health. Furuncles are seldom observed in the case of children. There is undoubtedly a micro-organism present to account for the inflammation, most frequently the staphylococcus pyogenes albus, which, according to Loewenberg, finds its way into the subcutaneous tissues through the gland-ducts. Furuncles are seen most frequently in the Spring and Fall of the year. The lumen of the canal may or may not be closed by the presence of one or more furuncles, which are found in the cartilaginous portion of the auditory canal. The glands of the neck are occasionally enlarged.

The **symptoms** are intense pain, aggravated at night and increased by movements of the jaw, fever, loss of appetite, and prostration occurs in severe cases.

In the early stage the artificial leech should be applied. Leiter's coil will be found useful in some cases. Hot drops containing morphia, atropia sulphate, or cocaine will alleviate the pain. The sulphide of calcium, in $\frac{1}{10}$- or $\frac{1}{20}$-grain doses every three hours, has seemed to me to have a most curative effect in many cases.

The furuncle should be incised whenever fluctuation is detected, and to prevent the recurrence of other furuncles, owing to the micro-organisms, the supersaturated solution of boracic acid in alcohol (Loewenberg) should be instilled in the ear, or drops containing mercuric bichloride (1 : 5000). Granulations sometimes spring up from the edge of an incised furuncle: when small in size they can be cauterized with nitrate of silver or chromic acid, but when of large size they should be excised with Blake's snare.

Owing to the debilitated and anæmic condition usually observed among these patients, it is well to prescribe a nourishing diet, tonics, and cod-liver oil.

8. Foreign Bodies.—(*a*) Inspissated cerumen is a frequent cause of deafness. When found in one ear, it is very apt to be present in the other, not complained of, so that it is always well to examine both canals. Cerumen may remain in the canal for years without causing apparent deafness, and in consequence may become very hard. To soften it a saturated solution of bicarbonate of soda containing some glycerin

Fig. 144.

Syringe.

should be warmed and dropped in the ear, and allowed to remain in the canal for several minutes at a time. This should be repeated several

times. A syringe (see Fig. 144) and warm water are the best means of removing cerumen. Only in skilled hands and under good illumination from a head-mirror should curettes or other instruments be employed. All syringing should be done very gently, as vertigo and great weakness are sometimes complained of. After the wax has been taken out the canal should be carefully dried with absorbent cotton and the ear inflated by Politzer's method; afterward a piece of absorbent cotton should be inserted in the canal. The latter should be worn only a day or two. (*b*) Laminated epithelial plugs, or keratosis obturans, is a cause of deafness in some instances, which is due to the gradual collection and accretion of epithelial laminæ derived from the external auditory canal. The soda solution is required in some cases to soften the mass, which should then be removed by syringing. Subsequent treatment should be directed to any inflammation of the canal, if present. The insufflation of boracic acid or of boracic acid and oxide of zinc will be found beneficial. Besides cerumen, other foreign bodies observed in the ear, more especially in the case of children, are onions, wads of cotton, pieces of paper, ends of lead-pencils, beads, beans, kernels of fruit, wheat, small stones, cherry-stones, etc. As previously mentioned, all instruments designed for removing foreign bodies are most dangerous except in skilled hands and when the surgeon has a good illumination and can see for himself the foreign body. As a general rule, the syringe and warm water are the best means of removing a foreign body. Before syringing, however, the surgeon should always satisfy himself of the presence of a foreign body.

Symptoms.—More or less deafness depending on the size, shape, and position of the foreign body. A sensation of pressure or tension and subjective noises, accompanied by more or less pain, according to the irritation and inflammation of the canal, drumhead, and middle ear. Unskilful attempts at removal of a foreign body lead to laceration of the canal and injury of the membrana tympani, and in rare instances to brain complications. Reflex phenomena are observed in some cases—viz. persistent coughing, pain in the head, vertigo, and vomiting. Epileptic attacks have been cured after removal of a foreign body.

When there is much inflammation it is well to first reduce this by the application of the artificial leech and the installation of hot drops. When the foreign substance is not wedged in and there is but little if any swelling or inflammation of the canal, syringing alone will usually be sufficient. It is advisable to incline the patient's head toward the affected side. Where foreign substances are likely to swell, Zaufal recommends the injection of oil instead of water, while Politzer pours alcohol into the ear for the same purpose. Hedinger, on the other hand, by experimentation has found that leguminosæ remain unchanged in glycerine.

When the membrana tympani is perforated injections of air through the Eustachian tube may assist in removing or dislodging a foreign body. Cockroaches and various insects, as well as maggots, get into the auditory canal. Instillations of oil or the vapor of chloroform will kill them, as well as Labarraque's solution of chlorinated lime or oil of turpentine.

When the syringe fails or for any reason seems unsuitable, it then

becomes necessary to resort to instruments, of which all sizes and shapes have been devised—viz. forceps, blunt and sharp hooks, curettes,

FIG. 145.

Sharp hook and curette.

(see Fig. 145) loop of wire, scoops, etc. No one instrument is adapted to all cases. It is frequently necessary to administer ether when the foreign substance becomes wedged in the deeper portion of the canal, and in the case of small children and nervous females. Displacement of the auricle by partial separation of its posterior attachment is advisable where the foreign body has become wedged in the deeper portion of the external meatus or in the middle ear. Loewenberg has revived an old method, which consists in dipping the point of a camel's-hair brush into a solution of glue, and then touching with it the foreign substance, which has previously been dried, and leaving it there until the brush sticks, and then withdrawing it with the foreign body attached.

9. EXOSTOSES.—These bony growths, when soft and pediculated, can be removed by the écraseur, snare, or small gouge or chisel. The true ivory exostosis, which is most frequently met with, consists of dense bone, white or yellowish in color, usually round, situated on the wall of the bony meatus, with a broad base as a general rule. Exostoses are found singly or in numbers, and may affect one or both canals. By gradually growing together the lumen of the canal may be diminished or even lost. Formerly gout and rheumatism were given as causes of these growths, but in my experience sea-bathing plays a much more important rôle. Exostoses may be due to syphilis, and in such cases mercurial and iodine preparations should be prescribed. When the exostoses are so large that they cause deafness by preventing the entrance of sound-waves, laminaria tents can be tried if they do not occasion too great pain. Otherwise, when closure of the canal has taken place, causing great deafness, the growths should be removed by small chisels or gouges or by dental drills, first recommended by Matthewson of Brooklyn.

In cases of long-continued suppuration from the middle ear the canal becomes very narrow from strictures due to ulcerations or from injuries or from the instillation of concentrated acids, etc. Constriction, or even closure, of the bony canal from enlargement of the bony wall may result from chronic suppurative otitis media, especially when cheesy masses collect in the middle ear and mastoid cells. In such, trephining of the mastoid is advisable to effect a cure.

10. ECZEMA, acute and chronic, may affect the external meatus, but the auricle is usually involved at the same time.

For the treatment of these conditions the reader is referred to what has already been said about Eczema of the Auricle.

11. SEBORRHŒA.—A seborrhœal condition of the canal exists at times, when it is apt to be associated with a seborrhœa of the face and scalp. It gives rise to more or less itching, deafness, and tinnitus. The canal contains moist scales and seborrhœal fluid.

After the scales have been removed the insufflation of the powder of

zinc oxide and boracic acid will cure the disease, in connection with attention to the general health. In some cases ointments containing ammoniated mercury or the red oxide are to be preferred.

12. Ingrowing Hairs.—Hairs from the auditory meatus at times are so thick and long that they interfere with the hearing, or they may even rest against the drumhead, giving rise to noises in the ear, especially when the patient moves his jaw. Epilation is required in extreme cases.

13. Sebaceous Tumors.—These tumors are found in the external auditory canal, and should be treated in the same manner as those in the auricle. Epithelioma at times attacks the external meatus primarily, but it is more apt to spread to the canal from the auricle or face.

14. Ear Cough.—This phenomenon is noticed frequently in patients when examination is made of the ear by the introduction of a speculum. Foreign bodies in the external meatus have been known to cause severe coughing. The explanation is that it is due to irritation of the auricular branch of the pneumogastric (which latter supplies the auditory meatus) being reflected to the superior laryngeal nerve.

15. Hemorrhage from the Ear. — Hemorrhage from the ear, besides being due to direct injuries from foreign bodies, may occur from fracture of the bony canal following a blow on the jaw. Bleeding from the ear (vicarious menstruation) has been reported as occurring in females during the menstrual period.

16. Cholesteatoma.—Cholesteatomatous masses form in the external meatus and middle ear at times, and lead to dilatation of the bony passages and to caries of the walls. Granulations follow and the ossicles are destroyed. Under the microscope, besides epithelial cells, cholesterin crystals are present. These masses should be thoroughly removed by syringing, curetting, and by scraping the bone in extreme cases. It is well to use bichloride solutions and iodoform powder. In some cases it is necessary to perforate the antrum in order to reach the masses contained in the mastoid cells. Granulations and polypi are at times met with in the canal when there has been no discharge, but most frequently they are attached to the edge of a furuncle that has been incised, or to a

Fig. 146.

Blake's polypus snare.

sinus leading to carious bone. Curettes and Blake's snare (see Fig. 146) are the instruments I prefer for removing the same.

17. Myringitis, *Acute and Chronic.*—This, as a disease *per se*, is denied by many otologists, who claim that the middle ear is involved at the same time. The drumhead may be congested in part only or in its whole extent. It is said to follow from a cold wind blowing across the ear or from a cold bath or sea-bathing. After the congestion an effusion of serum takes place in the dermal layer, which latter is usually the only

layer involved. Slight hemorrhages may occur, and abscesses form in the deeper or fibrous layer.

The **symptoms** are pain, tinnitus, and a sense of fulness. There is less deafness than in middle-ear disease. It is difficult to tell in some cases where myringitis ends and otitis media begins, as they may exist together.

In severe cases the artificial leech should be applied. In mild cases the vesicles burst and recovery follows in a few days. Some cases become chronic when suppuration ensues, and loss of the dermal layer is the result, and granulations spring up. There may also be ulcerations on the membrana tympani. The ear should be carefully syringed and dried with absorbent cotton on a probe, and afterward the powder of zinc oxide and boracic acid should be insufflated. Drops containing zinc sulphate, sulphate of copper, or lead (gr. iv or viij-℥j) will be necessary in some cases.

18. Injuries of the Membrana Tympani.—Injuries of the drumhead are usually the result of the introduction of a foreign body, a blow, or explosion causing a sudden condensation of air in the external meatus or tympanum, or a fracture of the cranial bones, thus involving the drumhead. Ruptures have been caused by inflating the ears too forcibly by Politzer's method, especially when the drumhead was atrophied; also when exhausting the air in the external meatus by Siegle's otoscope. Patients who try to clean their ears with tooth-picks, hair-pins, frequently push the same in too far. Other causes are unskilful attempts at removing a foreign body, the instillation of concentrated solutions into the canal, diving, the force of waves striking against the side of the head, boxing the ears, the discharge of cannon, and gunshot wounds. During violent paroxysms of coughing the drumhead is occasionally ruptured.

In cases where ruptures occur from the sudden condensation or rarefaction of air it will be found generally, on examination, that catarrhal changes have taken place in the membrana tympani, such as thickening, calcareous or atrophic changes, with more or less obstruction to the entrance of air through the Eustachian tube.[1]

The size and shape of the rupture or perforation in direct injuries depends to a great degree on the instrument used. A sharp-pointed instrument makes a rupture somewhat round, with more or less blood on the edges and in the auditory canal. A rupture thus made may or may not be followed by inflammation of the drumhead and middle ear. In injuries the result of indirect violence from falls, blows, loud noises, etc. the rupture is apt to be gaping, revealing the inner wall of the middle ear, of a pale-yellow color when seen immediately after the injury.

The **prognosis** depends on the fact whether the labyrinth is involved, also whether severe inflammation of the middle ear has followed, leading to permanent changes, such as thickening of the membrana tympani with adhesions. The most serious cases are those in which concussion of the labyrinth exists with or without rupture of the drumhead, the diagnosis being made with tuning-forks. The perception of sound when the tuning-fork is placed on the mastoid process is either lost in such

[1] Bacon, "Report of Twenty-one Cases of Traumatic Lesions," *N. Y. Med. Journal*, May 7, 1887.

cases or very much diminished; while the tuning-fork is heard much better by aërial conduction—*i. e.* when held close to the ear. Low-pitched forks are heard better by the air than the higher-pitched ones in such cases.

To determine whether a rupture is of traumatic origin the patient should be seen immediately after the accident; otherwise, if suppuration has supervened, it will be impossible to tell from an examination. When labyrinthine disease is found to exist, much will depend on the statement of the patient, for in catarrhal and other diseases bone-conduction may be very much diminished or lost.[1] In cases of concussion of the labyrinth benefit will result in some instances from the application of the constant electrical current. In other cases nerve tonics or the hypodermic injection of 5 or 6 drops of a 2 per cent. pilocarpine solution are indicated. Persistent tinnitus and permanent deafness remain frequently in spite of all treatment. In cases of simple rupture the patient should be kept quiet, the external meatus protected by a piece of cotton, and all syringing and instillation of drops carefully avoided. When inflammation and suppuration have taken place the treatment for acute inflammation of the middle ear should be carried out.

Diseases of the Middle Ear.

1. Acute Inflammation of the Middle Ear, or *Otitis Media Acuta.*—Acute inflammation of the middle ear may be either catarrhal or purulent. Otitis media catarrhalis acuta, or acute catarrhal inflammation of the middle ear, is most commonly known as "an earache" in children. The changes in the middle ear are congestion and swelling of the mucous membrane covering the tympanum and ossicles and inner surface of the drumhead. The hyperæmia is followed by more or less exudation of serous fluid and exudation-cells. In severe cases slight hemorrhages are observed, and it is probable that the lining membrane of the mastoid cells, in many cases at least, takes part in the same inflammatory process. The Eustachian tube is apt to be swollen, and the contents of the tympanic cavity consist of thick mucus, blood-corpuscles, and some pus-cells. This form of inflammation follows a cold in the head, and is noticed more often in the winter and spring months. The drumhead may or may not be perforated. Besides following a cold in the head, sea-bathing, and long exposure to wet and cold, other causes are the acute infectious diseases—viz. scarlet fever, measles, whooping cough, pneumonia, bronchitis, syphilis, etc.

Teething in children is a frequent cause of this disease, and the teeth should always be examined, not only in young children, but also in adults, as decayed roots and the eruption of the molar teeth may, through reflex irritation, act as an exciting cause. Patients who use a nasal douche get into trouble at times by having the water enter the middle ear through the Eustachian tube, and inflammation follows. Sniffing up salt and water should never be advised, for the same reason. Sea-bathing and pouring cold water into the ears, as many patients consider necessary to cleanse the ears, are fruitful sources of catarrhal otitis

[1] Bacon and Roosa, "An Account of a Suit for Damages in a Case of Alleged Injury by a Blow on the Ear," *N. Y. Med. Journ.*, Dec. 12–18, 1885.

media. Bathers should be cautioned always to wear cotton wool in the ears.

Pain is a prominent symptom in some cases, while in others it is not marked, depending on the degree of inflammation. Infants generally scream, and are apt to put the hand up to the head, while some throw their heads back, and thus suggest to the physician the possibility of a commencing meningitis. Delirium and convulsions occur at times, and there may be considerable elevation of temperature. The pain may shoot about the side of the head, and is often complained of on opening the mouth. It is a much more prominent factor in acute suppurative otitis media, and may be due to the inflammation itself or to the pressure due to the products of inflammation. We often see in children great retraction of the membrana tympani when the Eustachian tube has become closed from catarrhal inflammation, and in such after Politzer inflation there will follow usually great relief from the pain and deafness. Noises in the ear, pulsating, ringing, hissing, etc. in character, vary in different cases, as does also the degree of deafness, which latter will depend on the intensity of the inflammation and the interference with the transmitting mechanism. Owing to the anastomosis between the blood-vessels of the middle and internal ears, the labyrinth may in some instances be simultaneously involved. Autophony, or an unnatural sound of one's own voice, a feeling of heaviness or numbness in the head, are complained of by some patients.

Permanent disturbances of hearing result in some cases where the exudation is not wholly absorbed and thickening of the drumhead occurs. In all patients the nasal passages and nasopharynx should be most carefully inspected, and any adenoid growths should be removed. Gradle's forceps or the instruments of Politzer, Gruber, Loewenberg, and others will be found most useful for this purpose. Tonics, and especially the syrup of the iodide of iron in the case of children, should be administered, as adenoid growths are very often associated with a debilitated or scrofulous constitution.

In acute catarrhal otitis media the drumhead will be found hyperæmic—slightly so in mild cases, much more marked in others, according to the severity of the attack. The appearances vary from a slight hyperæmia around the upper part of the membrana tympani and along the handle of the malleus, to a deep livid color involving the entire membrane. Subsequently the dermal layer becomes sodden and detached, and the inner end of the canal may be congested as well. In some cases there is bulging of the drumhead, leading to perforation of the same; but when this occurs and the discharge becomes purulent, the case should then be considered one of acute purulent otitis media. The pain lasts from a few hours to several days in different cases. The inflammation when slight may disappear in a few days, but when occurring in debilitated persons or in those suffering from the acute infectious diseases, syphilis, or tuberculosis, the duration becomes much longer.

As to **treatment**, in mild cases attention to the general health, quiet and rest in the house for a few days, especially if the patient have a cold, will be all that is necessary. If the membrana tympani is very much retracted, owing to swelling of the pharyngeal orifice of the Eustachian tube, Politzer inflation, performed gently, will relieve the pain

and hasten the cure. When the inflammation is severe and the pain intense, the local abstraction of blood by means of my scarificator (see

FIG. 147.

Bacon's scarificator.

Fig. 147) and cupping-glass is our best method of treatment. The scarificator has seven lance-shaped needles, and the depth of the punctures can be regulated by screwing or unscrewing the cap on the end of the instrument. The cupping-glass (Fig. 148) should be immersed a few

FIG. 148.

Bacon's cupping-glass.

moments in hot water before its application, and should be applied to the parts just in front of the tragus or below the lobule, while, if mastoid symptoms are present, it should be applied to that region. In many cases, when used in the early stage, we can cut short the attack.

A mild calomel purge should be given, and hot drops of a saturated solution of boracic acid or drops containing 4 per cent. of cocaine, or morphia sulphate (Majendie's sol.), ℥j–℥j, should be prescribed. The hot douche is also valuable, but all poultices are worse than useless. In children warm water poured into the ear often relieves the pain at once. After the disappearance of all inflammatory symptoms the removal of the exudation and improvement in the hearing will be hastened by the use of Politzer inflation or the Eustachian catheter.

Besides local treatment for the ear, gargles should be prescribed when necessary, and tincture of aconite in drop-doses I find most invaluable when the otitis media follows a cold. Sponging the neck and chest daily with cold water is advisable for those who are subject to frequent colds, and such patients should always protect their feet in inclement weather. When there is bulging of the drumhead, with more or less pain, we should puncture the membrane in the lower segment or at the most bulging portion. Afterward it is generally best to blow out the secretion by Politzer's method or by using the catheter.

2. SUBACUTE CATARRHAL OTITIS MEDIA is a form of inflammation similar to acute catarrh, but milder in form. There is but little pain and inflammation. The patient is usually subject to frequent attacks of

the same, the tonsils are apt to be enlarged, and the disease is liable to become chronic. This variety is frequent among children who are said to be inattentive at school.

Proper hygienic surroundings, tonics, etc. should be prescribed, and treatment directed to the nares and post-nares with Politzer inflation.

The secretion in some cases may be almost wholly serous in character (otitis media serosa), and in such it is often necessary to do a paracentesis. In adults, and in all cases whenever possible, I prefer catheterization to Politzer's method of inflation.

3. Acute Suppurative Otitis Media, or *Otitis Media Suppurativa Acuta.*—Acute purulent inflammation of the middle ear is similar in character to acute catarrhal otitis media, except that in the former the inflammation is of a more severe type, the discharge contains many more pus-cells, and perforation of the membrana occurs much more frequently. The secretion may be almost wholly purulent or muco-purulent. In cases of tuberculosis the membrana tympani breaks down, and a perforation is the result, while the drumhead and middle ear are but slightly, if at all, congested. During the epidemics of influenza the inflammatory symptoms were very marked and the discharge from the ear was decidedly sanguinolent. Besides, as a result of colds and influenza, other causes are those already mentioned under Acute Catarrhal Otitis Media —viz. the acute infectious diseases, typhus, typhoid, pneumonia, etc., sea-bathing, dentition, and the nasal douche. The disease may follow injuries to the canal or membrana tympani from the improper use of instruments or from the application of caustic solutions. Scarlet fever, measles, and diphtheria are, however, the diseases which play the most important rôle in the causation.

The appearances of the drumhead before perforation has occurred vary from a slight pinkish injection to a deep purplish color, with or without implication of the inner portion of the meatus. Ecchymoses are observed in some cases, and an exudation of serum in the dermal layer will give the drumhead a sodden appearance. The membrane presents a bulging appearance; the dermal layer may peel off and reveal a deeply-congested membrane. Perforation takes place most freely in the anterior inferior or posterior inferior quadrant, less seldom in Shrapnell's membrane. Pulsation of fluid is often observed after perforation of the membrane. The perforation may be so small that it will be necessary for the patient to try the Valsalvan experiment to reveal to the surgeon its position. The discharge, at first serous, may also contain blood-corpuscles. Subsequently its character changes to muco-purulent or purulent. The pain is much more severe and more general, radiating about the head, jaw, and teeth, than in acute catarrhal otitis media, with more or less elevation of temperature.

Netter of Paris has made investigations as to the presence of micro-organisms in the discharge, and has found the following: (1) The pyogenic streptococcus of Netter, Zaufal, Moos, and others; (2) the pneumococcus of Fränkel; (3) the pneumobacillus of Friedländer; (4) the pyogenic staphylococcus of Fränkel, Rohrer, and others.

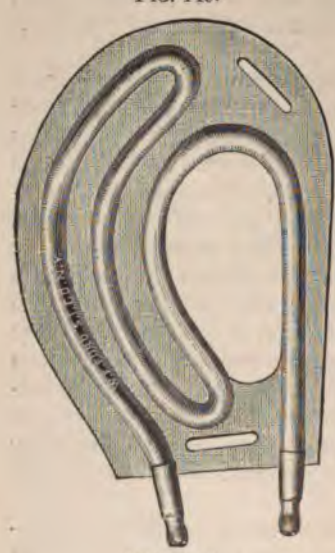
After suppuration has occurred there is generally great relief from the pain. Tinnitus is a prominent symptom, and deafness is dependent on the intensity of the inflammation and on the character and amount

of the discharge. Giddiness and vertigo are complained of in some cases.

In acute catarrhal and acute purulent otitis media tests with the tuning-fork show increased bone-conduction on the affected side, except when the labyrinth is involved. Perforation may occur in a few hours or after several days of suffering. Suppuration may continue for several days up to three or four weeks. The drumhead after closure of the perforation gradually returns to its normal appearance, or permanent changes follow, such as opacities, calcareous deposits in the membrane, adhesions between the ossicles or drumhead and middle ear, or secondary changes involving the labyrinth, which may be permanent. The perforation may be large and remain open. In cachectic and other patients the complications are caries of the ossicles and tympanic walls, pyæmia or septicæmia, facial erysipelas,[1] thrombosis of the lateral and other sinuses, mastoid disease, meningitis, and hemorrhage from the carotid canal or jugular vein, and brain-abscess.

In the hyperæmic stage the local abstraction of blood by means of the artificial leech is our most valuable method of treatment and will frequently cut short the inflammation. Douching the ear with hot water is to be recommended in many cases, and will tend to reduce the inflammation and promote the discharge. When there is simultaneous involvement of the mastoid cells the artificial leech should be used, and the Leiter coil (Fig. 149) applied at once. If seen early, I believe that almost every case of mastoid disease can be cured in this way. The coil is bound to the head by means of bandages, and ice-water, by the siphon principle, allowed to run through the coil by means of rubber tubing attached to it.

FIG. 149.



Leiter coil.

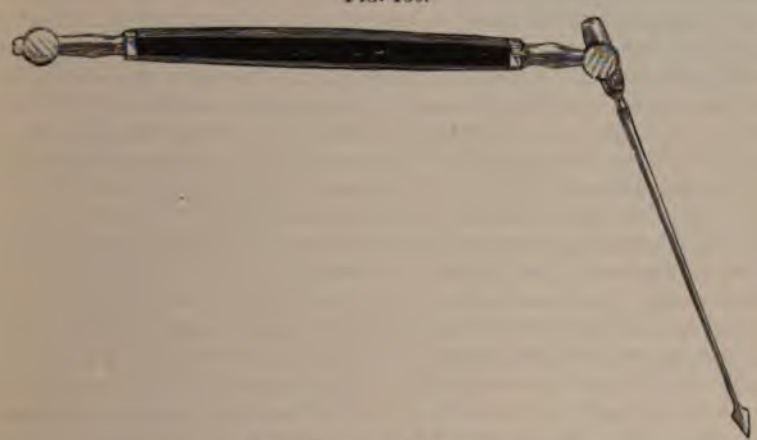
A case of malignant disease of the temporal bone may begin as an ordinary case of acute otitis media, so that we should bear this possibility in mind in cases attended with severe and lasting pain and in those that do not yield readily to the ordinary method of treatment.[2] Besides the local abstraction of blood, we should enjoin the patient to remain quiet in the house, avoiding stimulants and a rich diet. Calomel should be given as a laxative, and tincture of aconite in small doses in the early stages. Proper treatment should be directed to the pharynx and nasopharynx and nares. Drops containing atropine (gr. ij–℥j), or a saturated solution of boracic acid, or Majendie's solution (℥j to water ℥j), are to be recommended for the relief of the pain. If bulging, the membrana tympani should be punctured with a paracen-

[1] "Facial Erysipelas occurring as a Complication of Disease of the Ear," *Archives of Otol.*, vol. xvi., No. 2, 1887.

[2] *Archives of Otol.*, vol. xvii., No. 1, 1888.

tesis needle (Fig. 150), and the discharge promoted by hot douching of the canal. Poultices about the ear should never be used, and blistering with iodine or cantharides in acute cases cannot be too strongly condemned. After inflammatory symptoms have begun to subside a satu-

FIG. 150.



Paracentesis needle (Politzer).

rated solution of boracic acid should be dropped warm into the ear several times a day. Later, astringent solutions of zinc sulphate (gr. iv–vj–℥j) or of lead or copper can be used to advantage. From the dry method, so called, the insufflation of boracic acid or other powders, better results are obtained in chronic suppurative otitis media.

4. OTITIS MEDIA CATARRHALIS CHRONICA, or *Chronic Catarrhal Otitis Media*.—The acute form of catarrh or frequent attacks of the subacute variety may lead to chronic catarrhal inflammation of the middle ear.

In chronic catarrh there is more or less exudation in the middle ear, with adhesions between the ossicles and the inner wall of the tympanum, together with a growth of connective tissue in the mucous membrane. In consequence we notice thickening and retraction of the drumhead and great prominence of the short process, with displacement of the cone of light. With Siegle's otoscope we can determine the existence of adhesions. In this class of cases there is apt to be an hypertrophic condition of the mucous membrane of the nares, nasopharynx, and Eustachian tubes.

In another variety of chronic catarrhal otitis media instead of there being any secretion apparent there gradually occurs a thickening of the mucous membrane and ligaments, with fixation or ankylosis of the stapes to the foramen ovale. Deafness is very marked, with a very annoying and persistent tinnitus. The Eustachian tubes are usually freely pervious to the entrance of air, and the patient, as a rule, has a chronic atrophic rhinitis and granular pharyngitis, while frequently there is implication of the labyrinth, so that in testing with tuning-forks we will find a loss of bone-conduction.

Some portions of the drumhead may be drawn in and thickened, while atrophic changes occur in other parts, so that the membrana tympani becomes very thin and at times transparent and flaccid.

Ankylosis of the stapes with the fenestra ovalis was first described by Morgagni.

Besides, as a result of frequent attacks of catarrh or of ozæna or chronic nasopharyngeal catarrh, hereditary tendency plays a most important part in the causation of adhesive middle-ear catarrh. It may also occur during the course of many general diseases, such as tuberculosis, gout, syphilis, or from living in damp places, sea-bathing, abuse of alcohol and tobacco. Tinnitus is often continuous in the adhesive variety, while in the moist form the noise may be intermittent, and is usually much less distressing. It is more marked when the weather is damp and after severe mental exertion and bodily fatigue.

Of the greatest importance is attention to the patient's general health, and nerve-tonics are particularly indicated. In chronic catarrh, in the exudative stage, we must endeavor to freely open the Eustachian tubes by Politzer's method or by catheterization; sprays, etc. are indicated for nasal and nasopharyngeal catarrh. A solution of sodii bicarb. (gr. v–℥j) is used with benefit in some cases when injected into the middle ear through the catheter; likewise five or six drops of a 2 per cent. solution of pilocarpine. Various vapors have been used for the purpose of reducing the swelling of the mucous membrane, such as sal ammoniac, turpentine, ol. pin. æther., carbonic-acid gas, chloric ether, and iodine. A few drops of the latter (chloric ether 8 parts, tincture of iodine 2 parts) should be dropped in the Politzer bag, and the vapor forced into the middle ear through the catheter. Besides injections and vapors, the use of bougies is recommended by some otologists in obstruction of the tube. Siegle's otoscope is of service in breaking up adhesions in some cases. Patients with chronic catarrh are often greatly benefited by a change of residence to a mountainous climate.

For the improvement in hearing in adhesive catarrh numerous operations are performed, such as division of the posterior fold of the membrana tympani when very prominent, division of the tensor tympani, division of adhesions, removal of one or more ossicles. Attempts to remove a portion of the membrane and to maintain a permanent opening have been made by Sir Astley Cooper and many others. The introduction of an eyelet was recommended by Politzer, but all such procedures have proved almost useless. Of late years operations for the removal of the malleus or malleus and incus, or of all these bones, have been performed. In some few cases, where the membrane has not re-formed, some improvement in hearing has ensued. Removal of the stapes alone was advised, but the results were disappointing, while in some cases great vertigo and nausea followed the operation. The best plan of treatment is to do an exploratory tympanotomy, consisting in an incision in the posterior segment of the drumhead, and to watch the effect on the hearing-distance and tinnitus. By this means we can the better determine the condition of the ossicles, whether bound down by adhesions or not, and also note the improvement, if any, following division of the same. We can then decide as to the advisability of removing one or more ossicles. This operation should never be done until all other

treatment has proved unsuccessful, while the patient should be informed that success does not necessarily follow. In some cases the hearing has been made worse. The tinnitus is not generally benefited by removal of the ossicles.

5. Otitis Media Suppurativa Chronica, or *Chronic Purulent Otitis Media.*—This is one of the most important diseases, not only on account of its frequency, but also on account of the deafness caused thereby, and of various complications likely to arise, such as extensive caries of the tympanic cavity and mastoid cells, thrombosis of the lateral sinus, and other brain-complications. The mucous membrane in chronic purulent inflammation undergoes various changes. It becomes thickened from infiltration with round-cells and from the enlargement of blood-vessels and the formation of new ones. The tympanum contains muco-pus or pus, and, if granulations or polypi be present, blood mixed with the pus. Fatty changes take place in the mucous membrane and degeneration of the round-cells, so that the hypertrophy of the mucous membrane may disappear to a certain extent. Otherwise, chronic suppuration in the tympanum may lead to the formation of granulations and polypi, or destruction of tissue and ulceration may follow, leading to caries and necrosis; or we may have the formation of connective tissue producing a general fixation of the ossicles to one another and the tympanic walls. In consequence of this new connective-tissue formation the drumhead becomes firmly fixed and thickened, with occasional calcareous deposits in it. In some cases ossification of the membrane takes place, and in such the hearing is much affected. Operative procedures, consisting in the division of adhesions, the removal of the thickened drumhead and ankylosed ossicles, are frequently followed by considerable improvement in the hearing-distance. The perforation in the drum-membrane in chronic purulent otitis media varies very much in size from that of a pin-head to loss of the entire membrane. Perforations are generally situated in the lower anterior or lower posterior quadrant, but in a few cases we find a perforation in Shrapnell's membrane. Here the disease is apt to be followed by caries of the ossicles and surrounding walls. In some cases there occurs a closure of the perforation when the latter has not been very large. In others there remains an opening even after cessation of the discharge, or there forms a thin and delicate cicatricial tissue, in which the elastic fibres are wanting, which closes over the perforation. In this latter class of cases we frequently find the membrana tympani attached to the inner tympanic wall. Besides resulting from acute suppuration of the middle ear, chronic suppurative otitis media is most frequently seen in scrofulous and tuberculous subjects, and in children who have had severe attacks of scarlatina or diphtheria. Teething and neglect of treatment are also frequent causes.

To examine a case and determine the position and size of the perforation we should first syringe out the secretion with warm water, and dry the canal with absorbent cotton on a cotton-holder. Boracic acid in the water may be used to advantage in these cases, and when the discharge is fetid and carious bone undoubtedly exists, a mild bichloride solution should be used. Perforations occur singly in the membrane, or there may be two, or, very rarely, more. The degree of deafness depends on the duration of the disease and the changes in the drumhead and ossicles.

Tinnitus is present in some cases, and persists frequently in spite of treatment. Where there is a small perforation and pus is likely to be retained, head-symptoms may be complained of—viz. headache, mental depression, vertigo, and dizziness. Tuning-fork tests show increased bone-conduction, except when the labyrinth is involved, and then it is diminished or lost. A perforation in Shrapnell's membrane is a difficult one to heal, as it leads to a series of cavities which do not generally communicate with the tympanum, and caries is apt to ensue from the discharge being unable to escape.

As regards treatment, after syringing and drying the canal, astringent drops, containing sulphate of zinc, sulphate of copper, or acetate of lead (gr. iv–viij–℥j), should be used several times a day, according to the amount and character of the discharge. Powders of boracic acid or boracic acid and zinc oxide (equal parts), or boracic acid with 50 per cent. of tinct. hydrastis canadensis, should be insufflated when the perforation is large, but the powder should never be packed in, as pyæmia has resulted from this practice.

When the perforation is small it should be enlarged if the pus does not escape freely from the tympanum. In cases of attic suppuration, and when the perforation is large, we should endeavor to wash out the

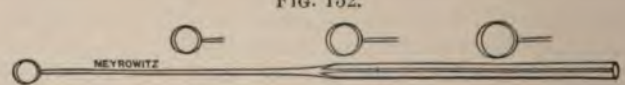
FIG. 151.

Hewitt's apparatus for syringing the middle ear.

cavity with the middle-ear syringe, and that devised by Dr. J. Hewitt (see Fig. 151) will be found most serviceable for this purpose.

In some instances we can cauterize the granulations with nitrate of silver or chromic acid fused on the end of a probe, but when the granu-

FIG. 152.



Sharp curettes, three sizes.

lations are of large size we must resort to the use of Blake's snare or remove them with curettes. (See Fig. 152.) The so-called alcohol treat-

ment, consisting in the instillation of alcohol combined with boracic acid or iodoform in the proportion of twenty grains of the powder to one ounce of alcohol, I have used with much success when granulations were present and when there was more or less caries of the walls.

Constitutional treatment is of the highest importance. Cod-liver oil, tonics, syrup of the hypophosphites of lime and soda, and iron, especially the syrup of the iodide in the case of children, should be prescribed. The nasopharynx should always be examined, and adenoid growths excised if present, and appropriate treatment by means of the atomizer and sprays is highly important for the nasal passages.

It is in the surgical treatment of these cases, where the suppuration is kept up by a carious condition in the upper portion of the middle ear, antrum, or tympanic walls, that we are apt to obtain very brilliant results. Before operating all instruments, bandages, etc., should be thoroughly sterilized, while the operator and his assistants should be careful to have everything as aseptic as possible. The ear should be syringed with a bichloride solution (1 : 5000), and for dressings I prefer iodoform powder and gauze.

There are, however, a large number of cases where the walls are carious as well as the ossicles, and in such it is necessary to either cut away a portion of the external bony canal or to perforate the bone down to the antrum, and thus remove any cheesy matters which so often collect in this cavity. Cholesteatomatous masses in the attic are frequently the cause of chronic suppuration from the ear, and can only be removed by surgical interference.

6. Polypi of the Middle Ear.—Polypi attached to the middle ear consist of (1) mucous polypi, (2) fibromata, (3) myxomata, and (4) angiomata.

(1) *Mucous polypi*, about 50 per cent. of all polypi, are identical in structure to nasal mucous polypi. The point of attachment is usually the mucous membrane of the middle ear. A mucous polypus consists of areolar connective tissue containing in its meshes round cells and at times stellate and spindle-shaped cells. The blood-vessels are numerous. These polypi are irregular in shape, owing to their structure, as they contain glands and papillæ. Pavement epithelium is found on the surface of the polypus directed externally, while on the inner surface, directed toward the tympanum, the epithelial covering is of the cylindrical or ciliated-cylindrical variety.

(2) *Fibromata.*—This variety is of a much slower growth, harder, and springs from the periosteum of the middle ear or auditory canal. It has fewer blood-vessels than the preceding variety, and consists of fibrillar connective tissue with some spindle-cells in its meshes. The surface is covered by pavement epithelium.

(3) *Myxomata.*—This variety is extremely rare, one such having been excised by Schwartze, who says: "From its external appearance it seemed to be gelatinous. Its epithelial covering consisted of a multiple layer of pavement epithelium, into which flat papillæ, like those of the cutis, projected. The stroma was crossed by an anastomosing network of spindle- and star-shaped cells. On the surface of the tumor, and also in the neighborhood of the blood-vessels, these fibrillæ were especially numerous, in the former case in layers parallel to the sur-

face of the tumor, in the latter case in layers concentric to the blood-vessels."

(4) *Angiomata.*—These growths bleed freely, as they contain many blood-vessels, whence the name "angioma cavernosum." According to Virchow, the arteries communicate with a network of spaces, and from the latter the blood passes through the veins again into the general circulation. Cases of angiomata have been reported by Buck and others.

Polypi when of small size may not interfere with drainage from the tympanum, but when large, so as to interfere with the escape of pus, a sense of fulness and pressure is complained of, together with vertigo and tinnitus, and, if not relieved, the disease will lead to mastoid disease and brain-complications.

One of the most frequent symptoms of the presence of polypi is the appearance of blood in the discharge from the ear.

Treatment.—When small in size, as previously mentioned, polypi can often be removed by cauterizing them with chromic acid or nitrate of silver, or by the so-called alcohol treatment, especially when there is caries of the ossicles and tympanic walls. In the latter class of cases it is well to add iodoform to the alcohol. When a polypus is larger in size or the treatment just mentioned fails, we must use Blake's snare, or with sharp curettes or spoons remove the growth, always cauterizing with nitrate of silver or chromic acid the base of the growth. Frequently the ossicles will be found in a polypoid mass after removal. The insufflation of boracic-acid and oxide-of-zinc powder (equal parts) answers admirably in the after-treatment; also iodoform powder when carious bone exists.

Caries of the temporal bone occurs as a result of long-continued suppuration in weakly or tubercular or syphilitic individuals, and as a result of the presence of cholesteatomatous masses, which cause ulceration through pressure. In some cases large sequestra are found and facial paralysis is an occasional complication.

As a result of suppuration, in some instances we find a thickening or enlargement of the osseous walls of the external meatus, so that the canal becomes almost closed, thus preventing the escape of pus. In other cases membranous bands form in the middle ear and canal and prevent proper drainage. In the former it is often necessary to trephine over the antrum or to chisel away enough bone to allow the pus to escape. The bands should be divided and attempts made to dilate the meatus by introducing a rubber drainage-tube.

Where there is extensive caries of the temporal bone we should endeavor to remove all sequestra, establish drainage through the external auditory canal or by cutting down on the antrum, and scrape the carious bone, while we build up at the same time the patient's general health with tonics and cod-liver oil.

Many of these cases are undoubtedly tubercular, and I have frequently seen the patient's general health improve very rapidly after all carious and cheesy masses had been scraped away.

7. Mastoid Disease.—Under normal conditions the mastoid process consists of the antrum, situated above and behind the tympanum (see Fig. 153) and in direct communication with it, and also of a number of cells, the majority of them probably opening one into the other.

These contain air and are lined with a continuation of the mucous membrane of the tympanic cavity. Those cells which are not pneumatic usually contain a fatty substance. The upper wall of the antrum is but

FIG. 153.

a, external auditory meatus; *b*, antrum; *c*, mastoid cells.

a thin lamina of bone, separating it from the dura mater. The lateral sinus is in close proximity to the mastoid cells, and rests against the inner wall of the process. The facial nerve may be involved in a case of mastoid disease, as after passing through the aquæductus Fallopii its course is downward through the cells.

In the light of anatomical investigations we know that no two mastoid processes are exactly alike. According to Zuckerkandl, who made an examination of one hundred mastoid processes in the fresh state and one hundred and fifty macerated ones, there were absolutely no air-cavities in 20 per cent. of the specimens. Of the entire number, $38\frac{6}{10}$ per cent. were perfectly pneumatic mastoid processes, without any diploëtic spaces. He also found that in some persons only the upper half of the process was pneumatic, while the lower half was diploëtic. These facts explain, in a way, why in one individual suffering from middle-ear disease the mastoid cells, when large and pneumatic, may easily be the seat of a severe inflammation from the first. It is probable that in a great many cases of otitis media the mastoid cells participate in the inflammatory process. The latter should anatomically be considered a part of the middle ear, as disease of the latter almost always precedes mastoid disease, primary inflammation of the mastoid alone being extremely infrequent.

In an infant at birth there is usually but one cell—viz. the antrum—the mastoid process being but a small tuberosity and undeveloped. The antrum in the early months of infancy is covered externally by a very thin wall of bone, which latter is covered by periosteum, while an emissary vein from the mastoid frequently perforates this thin partition of bone. It is easy to understand from these facts why in infants a large swelling frequently appears behind the ear in a very short space of time, even when there may not have been any discharge from the ear at the time, or if present a very slight one. An incision made in such an abscess is frequently all that is necessary to bring about a cure, provided there is no carious bone connected with it. At five years of age the mastoid process of a child is very similar to that of an adult as regards the position of the antrum and arrangement of the cells, but it is smaller, and the bony substance is not as firm and dense as in later life.

Primary inflammation of the mastoid cells without implication of the tympanum, although occasionally observed, is very infrequent. Some writers have published reports of cases where the periosteum covering the mastoid cells was alone involved (primary periostitis mast.), characterized by the formation of a hard and painful swelling over the mastoid process. In such cases the tympanum appeared normal, but in the external meatus there was a slight congestion of the posterior wall. A prominent symptom is violent pain, which radiates over the head. The fever is slight, but somewhat elevated when pus forms. If left alone to nature, suppuration is liable to follow.

The **treatment** consists in the application of my artificial leech, fol-

FIG. 154.

Author's ice-bag.

lowed by the use of the Leiter coil (see Fig. 149) or of an ice-bag (see Fig. 154). If not relieved in this way, an incision should be made down to the bone.

In some cases of otitis externa circumscripta and otitis externa diffusa the inflammation may extend to the periosteum covering the mastoid cells, leading to death of the underlying bone, or periostitis may be secondary to acute otitis media; but whenever pus is found under the periosteum covering the mastoid process the bone should be most carefully examined to see if a sinus, even very small, does not exist, and that the pus does not come from the interior of the mastoid cells.

Secondary inflammation of the mastoid is the form most frequently observed. The disease spreads from the middle ear through the antrum, and may follow an acute catarrhal or acute suppurative otitis media or occur as a result of a chronic suppurative inflammation of the middle ear, frequently of very long standing. The pain in acute cases develops suddenly and is very severe, shooting about the side of the head, and is worse at night. The patient has an anxious appearance, and there may or may not be fever, with tinnitus and giddiness in some cases. The tissues over the mastoid may be swollen and hot and œdematous, very tender on pressure, or without any redness or swelling there may be simply great pain whenever pressure is made over the mastoid antrum and apex. In some cases the discharge of pus from the ear is scanty, in others profuse. Frequently one notices a swelling or bulging of the posterior and upper part of the auditory canal and drumhead. In such, an early incision in these parts to relieve the tension is most important.

I believe that if a case of acute inflammation of the mastoid cells be seen in the first stage, the disease can be aborted at once by applying the artificial leech and afterward the Leiter coil. A dose of calomel should be given, and also drop doses of Fleming's tincture of aconite every hour.

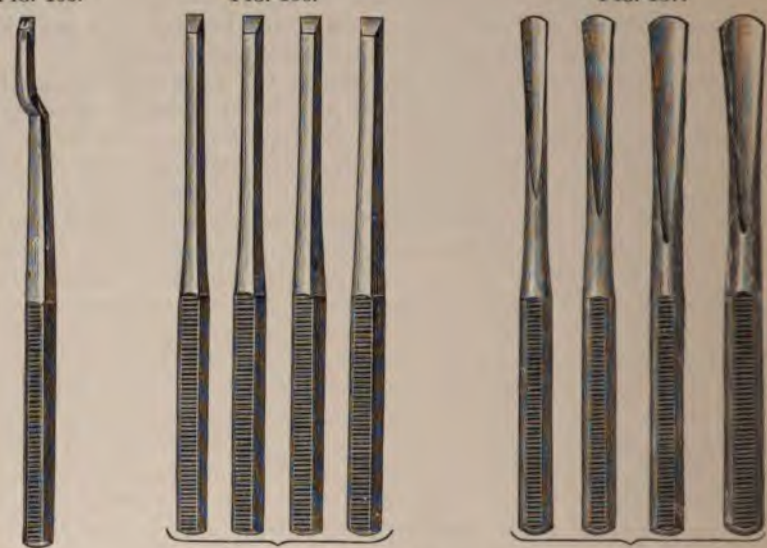
Mastoid disease, besides occurring in patients who are debilitated or run down, is often seen in scrofulous, tubercular, and syphilitic patients. It may follow a cold or result from injections into the middle ear or from improper treatment of the latter. Occasionally, but very seldom, both mastoid processes are involved. I have reported such a case[1] where it was necessary to perforate with chisels both mastoid processes, and in which the case was further complicated by typhoid fever, but recovery ensued. If, in spite of the treatment above mentioned, pain, fever, tenderness on pressure, etc. continue, we must not hesitate to open the mastoid cells. After the Leiter coil has been in place for twenty-four hours it should be left off for an hour or two, to see if the pain returns; otherwise the cold may mask some of the symptoms.

When about to perforate the mastoid process the hair should be shaved for at least two inches from the ear, and the skin scrubbed with soap and water and washed with a bichloride solution (1 : 2000). The most thorough antiseptic precautions are necessary on the part of the operator and his assistants. The incision should be made after the administration of ether, close to the insertion of the auricle, from one and a half to two and a half inches in length. The periosteum should be divided and carefully pushed aside. It is better to make a long incision, so as to be able to examine the bone very carefully for the existence of a sinus. If found, we should enlarge this with chisels and gouges. (See Figs. 155, 156, and 157.) When no fistula is found nor

[1] *N. Y. Eye and Ear Infirmary Reports*, Jan., 1893.

carious bone, it is well to open the mastoid a quarter of an inch below the linea temporalis—*i. e.* at a point slightly below and behind the superior wall of the external auditory canal. Grooved chisels, prefer-

Fig. 155. Fig. 156. Fig. 157.



Schwartze's chisels.

ably Schwartze's, should be used at first, and a funnel-shaped opening made, with the apex pointing inward. The bone should not be entered at a depth greater than five-eighths to three-fourths of an inch, for fear of injuring the facial nerve and external semicircular canal. There is also danger of wounding the lateral sinus and dura mater in either the posterior or middle fossæ unless we use the chisels in a direction forward and inward and take off layer by layer of bone. We should chisel away considerable bone, in some cases the entire mastoid cells. In chronic cases the antrum should always be opened, so as to remove all cheesy products that are liable to accumulate there, and also to establish a communication with the external meatus, and thus secure better drainage. In acute cases it is not always necessary to open the

Fig. 158.

Sharp spoons.

antrum. We must not forget that in many cases pus may not be found in the upper portion of the mastoid cavity, while if we open the apex we frequently find it filled with pus, softened bone, and granulations.

All cheesy products, softened bone, and granulations should be most thoroughly removed with curettes and sharp spoons. (See Fig. 158.) The cavity should be washed out with a bichloride solution. In acute cases, where there is but little pus and only a few cells are involved, and there is no communication with the middle ear, we can allow a blood-clot to form, and close up the external wound with sutures if we thoroughly remove all diseased matter and bone. In chronic cases and in those where there is a communication between the middle ear and external meatus we should suture the upper portion of the wound, but leave the lower portion open, and for this purpose it is best to insert a piece of iodoform gauze in the wound. The ear should be covered with iodoform gauze, a layer of absorbent cotton placed over this, and the whole bandaged.

In ordinary cases the patient should be kept quiet in bed for several days and allowed a light diet.

The dressings should not be disturbed for forty-eight hours unless the patient has pain or there is some elevation of temperature. After a week in the hospital, if the temperature be normal and the case progress favorably, there is no reason why the patient should not be allowed to go home if the weather be seasonable, and be treated as an out-patient.

I have reported a case[1] of mastoid disease following an operation for the removal of adenoid vegetations. Septicæmia and pyæmia are complications liable to occur when the operation of opening the mastoid is too long delayed. I operated on such a case,[2] the patient presenting himself when blood-poisoning had already occurred. Pyæmic abscesses were opened in different parts of the body. The patient recovered. Similar cases have been reported by J. B. Emerson and others.

The aural surgeon should be prepared to meet all emergencies and complications resulting from suppuration of the mastoid cells—viz. cerebral abscess, thrombosis of the lateral and other sinuses, meningitis, caries and necrosis of the temporal bone, and, in rare instances, hemorrhage from the jugular vein and carotid artery.

The first[3] operation in this country for cerebral abscess following disease of the ear was performed by Dr. Robert F. Weir and myself. The patient was under my care at the New York Eye and Ear Infirmary for suppurative inflammation of the middle ear, with extensive necrosis of the temporal bone. He had had a purulent discharge from the ear for the preceding two years. The mastoid process was perforated by me in two different places, and was very dense, but did not contain pus. Subsequently an abscess was located in the temporo-sphenoidal lobe and the pus was evacuated. The patient's condition improved somewhat for a time, but he passed into a comatose condition. The immediate cause of death was secondary hemorrhage from a vessel in the brain.

The more common **symptoms** of brain-abscess are pain about the ear and side of the head, radiating toward the occipital and frontal bones, which may be continuous or intermittent; rigors and vomiting; tongue coated; temperature but little elevated in the early stage; percussion over the side affected causes pain, while slow cerebration becomes marked, and the patient tries to fix his attention and to answer questions; aphasia

[1] *Trans. Amer. Otol. Soc.*, 1892. [2] *Ibid.*, vol. iii. Part 4, 1885.
[3] *Ibid.*, 1888.

when the abscess is located on the left side; tendency to sleep becomes gradually more marked in the later stage. A slow and full pulse and a temperature but slightly above normal, at times subnormal, are symptoms extremely characteristic of cerebral abscess. In some instances, however, the temperature is quite high and the pulse rapid. The respirations, usually slow, may at times be of a Cheyne-Stokes character. Convulsions, coma, and paralysis occur in some cases, while there may or may not be optic neuritis. The discharge from the ear frequently has a foul odor and is scanty.

Abscesses in the brain due to ear diseases are, as a rule, located in the temporo-sphenoidal lobe or in the cerebellum.

We must not forget that the lamina of bone forming the roof of the tympanum is very thin, and that in cases of long-standing middle-ear suppuration the pus is likely to find its way through this wall and into the middle cranial cavity, especially when the mastoid process does not contain many pneumatic cells. The bone which separates the mastoid cells from the lateral sinus is also very thin, so that when erosion of the bone occurs, inflammation may extend to the lateral sinus, causing thrombosis of the same, and emboli may be thus transmitted to the cerebellum and form an abscess, or the cerebellar abscess may be developed by direct inflammation through the dura mater, or in rare instances by inflammation extending to the cerebellum through the sheath of the auditory and facial nerves in their passage through the internal auditory meatus. Abscesses are also found between the dura mater and pia mater. Cerebral abscesses may become encapsulated or absorbed, or may discharge into the middle ear. There may be one or more abscesses formed.

The **prognosis** of brain-abscess was formerly most unfavorable, but since operative procedures were undertaken by Weir, McBurney, Ballance, Greenfield, Horsley, Barker, Thomas Barr, Macewen, and many others a number of successful cases have been reported.

In all operations on the mastoid antrum and cells, and when opening the cranial cavity, the most thorough antiseptic precautions should be followed. Towels soaked in bichloride should be wrapped about the head and shoulders, leaving exposed only those parts to be operated on. I prefer to use only absorbent cotton which has previously been soaked in bichloride solution, instead of sponges. Besides scalpels and retractors, it will be necessary to have a mallet, gouges, chisels of different sizes, a periosteal elevator, forceps for controlling hemorrhage, probes, a trephine for removing a button of bone in cases of abscess of the brain, etc. The instruments should be made aseptic.

In a case of suspected brain-abscess, after exploring the antrum and removing all cheesy products, we should then turn our attention to the tegmen tympani. The ossicles, if carious, must be removed, together with any granulations and carious bone. We should examine carefully with a probe to see if a sinus exists in the upper tympanic wall. If not, and we suspect a temporo-sphenoidal abscess, we can carry the incision previously made upward above the zygomatic process, and with a trephine remove a disk of bone 3 cm. in diameter at a point (see Fig. 159 point c) from $2\frac{1}{2}$ to 3 cm. above the external meatus. It is probable that most abscesses in this region are the result of inflammation extending from disease of the antrum. After removing the disk of bone, if

the abscess be large, there will probably be some bulging of the dura mater into the opening. There may or may not be absence of cerebral pulsation. The dura should be divided and the arachnoid and pia mater examined. By means of a hypodermic syringe and needle the

FIG. 159.

A, External auditory meatus; *B*, *B'*, Reid's base-line running from lower margin of orbit through the centre of the external auditory meatus; *C*, trephine opening two centimetres in diameter to expose temporo-sphenoidal abscess, centre-pin of trephine being placed three centimetres above the centre of the external bony meatus; *D*, point at which the mastoid antrum should be opened; *E*, *E'*, position of lateral sinus; *F*, trephine opening, two centimetres in diameter, for exposing lateral sinus, centre-pin of trephine being placed at a point two and a half centimetres behind and six centimetres above centre of external bony meatus; *G*, trephine opening for cerebellar abscess, centre-pin being placed five centimetres behind and six millimetres below external bony meatus.

different portions of the brain can be explored for abscess. The needle should be introduced so as to cover the cranial surface of the tegmen tympani. After the pus has been evacuated the abscess-cavity should be washed out with a very weak boracic-acid solution, and but very little pressure should be used; otherwise the brain-substance may be injured. It will be necessary in some cases to leave a drainage-tube *in situ*, especially when the abscess-cavity is very foul and the pus is fetid. When a drainage-tube has been inserted and there is a discharge of pus, the parts should be irrigated with a weak boracic-acid solution, and afterward covered with iodoform gauze and absorbent cotton and bandaged. Surgeons in some instances, when there is a chance of healing of the aseptic wound, reinsert the disk of bone. If there be much discharge, the dressings should be changed each day.

Abscesses in the cerebellum are frequently associated with sinus-thrombosis, and it is well in suspected cases to make an opening with the trephine, so as to explore the lateral sinus. (*E*, *E'*, Fig. 159.) A thrombus having been found in the lateral sinus, the same process may extend to the torcular Herophili, and thence to the superior longitudinal sinus and other sinuses. According to Ballance, the most important signs that should be looked for in a case of suspected lateral sinus-thombosis are—

1. A history of purulent discharge from the ear for a period of more than a year;
2. The sudden onset of the illness, with headache, vomiting, rigor, and pain in the affected ear;
3. An oscillating temperature, reaching to 103° or 105° F., and then dropping, say, below 100°;
4. Vomiting, repeated day by day;
5. A second, third, or more rigors;
6. Local œdema and tenderness over the mastoid or in the course of the internal jugular vein;
7. Tenderness on deep pressure at the posterior border of the mastoid and below the external occipital protuberance;
8. Stiffness of the muscles of the back or side of the neck;
9. Optic neuritis.

Optic neuritis may or may not be present, as it is not a constant symptom. Pressure on the pneumogastric, spinal accessory, hypoglossal, and glosso-pharyngeal nerves may cause muscular paralyses. When the cavernous sinus is involved there may be exophthalmus, œdema of the retina, and swelling about the forehead, eyelids, and nose. In some cases there may be ptosis or squint.

The **treatment** of sinus-thrombosis consists, first, in the thorough exploration of the antrum, tympanic cavity, and mastoid cells, and the removal of carious bone, granulations, and cheesy products. Afterward, the head having been shaved and the same aseptic precautions having been carried out as in the operation for cerebral abscess, the skin and subcutaneous tissues must be divided and the sinus exposed by removing with the trephine a disk of bone one-half to five-eighths inch in diameter. The centre of the trephine should be at a point (*F*, Fig. 159) one inch behind the centre of the external auditory meatus and about a quarter of an inch above it. With an exploratory needle we should determine as to the existence of a thrombus. If present in the lateral sinus, the internal jugular vein should be ligated below the thrombus in two places and divided between, and then the thrombus should be removed together with any fetid pus. The sinus is then to be washed out with mild bichloride solution, the hemorrhage controlled by plugging the sinus, and iodoform dressings applied.

By enlarging the opening made at this point we can, if necessary, explore for a cerebellar abscess if the indications point in that direction.

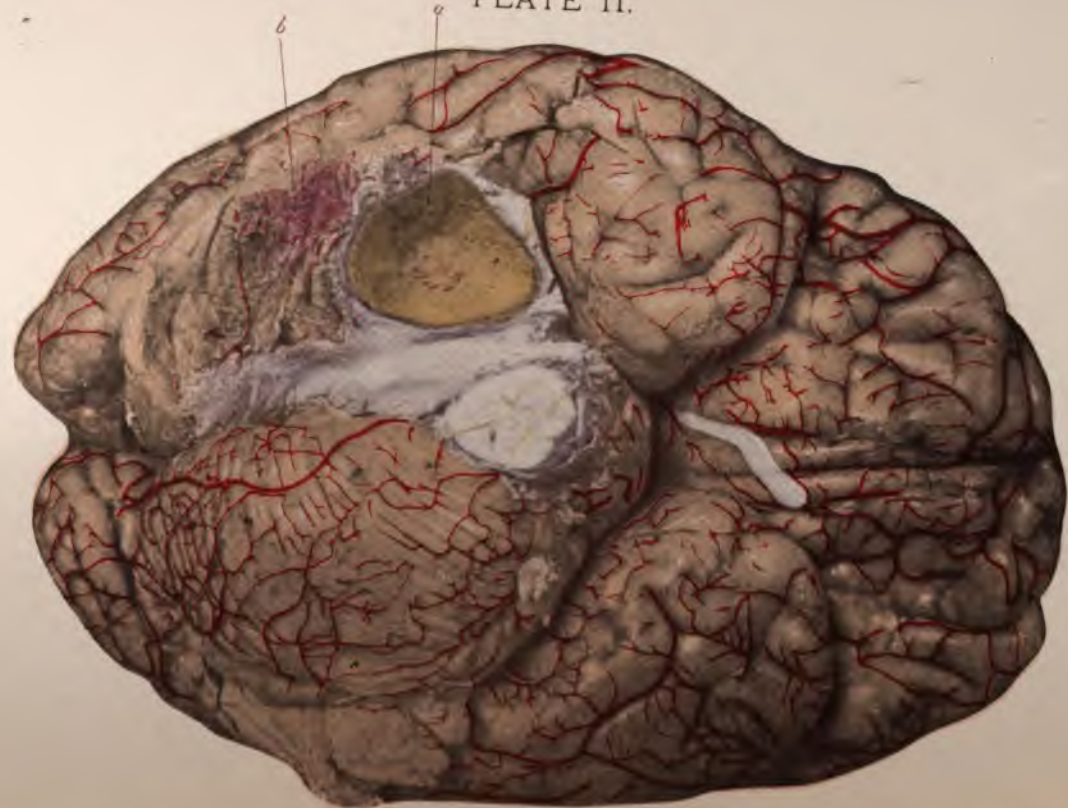
In other cases of suspected cerebellar abscess, a button of bone can be removed with a trephine by placing the centre-pin of the trephine at a point (*G*, Fig. 159) a distance of 5 cm. behind and 6 mm. below the centre of the external auditory meatus.

I have reported a case of cerebellar abscess[1] in which I not only removed a button of bone at the previously-mentioned point, *G*, having first laid bare with chisels the lateral sinus, but also trephined the skull at point *C* (Fig. 159), to investigate the temporo-sphenoidal lobe and the upper wall of the tympanic cavity.

The case was that of a male aged thirty-one years, who had a purulent discharge from the right ear for five years. When admitted to the hospital the prominent symptoms were nausea, vomiting and vertigo.

[1] *Amer. Journ. Med. Sciences*, Aug., 1895.

PLATE II.



Abscess of cerebellum secondary to chronic suppurative otitis media. The right cerebellar hemisphere has been divided and the lower half removed, exposing the abscess cavity and its wall (a), and the area of hemorrhagic softening posterior to the abscess (b).

The vertigo was present when lying down, but was much more marked when he tried to stand, with a tendency to fall laterally. He also complained of severe pain in the head. He had a staggering gait from the first, with a tendency to fall to the left; other symptoms were facial paralysis (right side), œdema of the right optic nerve, slow pulse, and a temperature but slightly above normal.

At the autopsy an abscess was found in the right cerebellar hemisphere. (See Pl. II.)

The more prominent **symptoms** of purulent meningitis are severe headache, at first intermittent and limited to certain portions of the head, but eventually spreading over the entire skull; vomiting, loss of memory, sleeplessness, convulsions about the face and neck that may become general. The pupils, contracted at first, react but little to light, but when paralyses occur they dilate, often unequally. The temperature is usually high, but does not show marked fluctuations, as in pyæmia and thrombosis. The pulse is rapid.

OTALGIA.—In this affection there is absence of every sign of inflammation in the ear. The pain is usually reflex, and is most frequently caused by decayed teeth. It may also arise from some laryngeal inflammation.

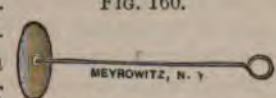
Nervous otalgia may be localized in the external or middle ear, being due to an affection of the sensory nerve or nerves supplying the ear. The most frequent causes of such are hysteria, cold, inflammation of the nerve-trunks, and pressure on them from tumors of the brain or from caries and necrosis of the temporal bone.

Otalgia is at times connected with neuralgia of the fifth nerve.

The Artificial Membrana Tympani.—When the drumhead is perforated or there is loss of one or more of the ossicles an artificial drumhead, consisting of a pellet of absorbent cotton smeared over with vaseline, will often, by the support it affords to the ossicles, increase quite perceptibly the hearing-distance. The best results are usually obtained when the pellet presses against the stapes, and it should be so placed as to convey the sound-waves to that bone.

The artificial membrane should never be used in cases of chronic purulent otitis media until all discharge from the ear has ceased. Otherwise serious symptoms are liable to ensue. Small disks of rubber (Toynbee) (see Fig. 160) have been recommended, but these are liable to set up irritation and inflammation of the canal and middle ear. In an artificial drum devised by Field of London "a small wire is carried beyond the India-rubber and terminates in a second disk made of flannel. The space between the two is filled up with a small portion of Dr. Von Brun's absorbent wound-dressing cotton-wool, which takes up and communicates to the flannel disk any medicated solution which it may be desirable to apply."

FIG. 160.



Toynbee's artificial membrana tympani.

Blake of Boston, in cases of relaxed drumhead when the ossicles need support, applies a small disk of very thin, sized letter-paper, which has been previously moistened in water, and which readily adheres to the drum membrane. The paper disk is also useful in perforations of the drumhead by stimulating new growth from the edges of the perforation

and protecting it until repair is effected. "The paper is removed by a natural process of repair and growth of the dermoid coat."

Diseases of the Internal Ear.

There may be want of development in the different parts of the internal ear—viz. the semicircular canals, vestibule, cochlea, or the foramina rotundum or ovale. The labyrinth is very seldom the seat of primary inflammation, although I have seen one such case in the course of an attack of influenza. A fracture of the temporal bone from a fall or blow may cause nerve-deafness as a result of effusion of blood or serum in the labyrinth or of direct laceration or injury of the nerve itself.

Various brain-tumors, abscess, meningitis, atheroma, aneurysm, malignant growths, beginning in the temporal bone, are other causes of labyrinthine deafness.

The general constitutional diseases are very prominent factors in the causation of disease of the labyrinth, such as syphilis, mumps, locomotor ataxia, typhus and typhoid fevers, meningitis, leukæmia, and hysteria. Quinine in large doses and salicin, the abuse of alcohol and tobacco, are responsible for some cases.

Nerve-deafness occurs also, as previously mentioned, as a complication of sclerotic catarrh of the middle ear. Diseases of the auditory nerve itself should also be mentioned—viz. atrophy, inflammation, hemorrhage, and various pathological changes; also concussion of the labyrinth from blows and falls.

The **symptoms** of labyrinthine deafness are subjective noises in the ear or head, giddiness, vertigo, vomiting, nausea, impairment or loss of bone and aërial conduction of sound, tone-deafness, and in some instances an hyperæsthesia of the auditory nerve.

The drum-membrane when examined with a speculum and head-mirror appears to be normal. The tuning-fork then becomes the surest guide in arriving at a diagnosis. Politzer's five forks are best adapted for this purpose.

In a case of labyrinthine deafness the low-toned forks are heard better than the higher ones by aërial conduction, if any fork is heard at all; while in disease of the middle ear, if the nerve be not affected, the reverse is true—*i. e.* the higher forks are heard better. In disease of the labyrinth the bone-conduction becomes very much impaired or lost. In the case of a normal ear a tuning-fork vibrating should be placed on the mastoid process, and the surgeon should be notified by a signal from the patient when he ceases to hear the sound. If the fork is then held close to the meatus, it will still be heard several seconds longer. In middle- or external-ear diseases the tuning-fork will be heard much longer when placed on the mastoid than when held close to the meatus. In a case of deafness where the labyrinth is involved the bone-conduction becomes impaired or lost altogether.

1. Ménière's Disease.—The symptoms are sudden faintness, perspiration, rapid pulse, loss of consciousness in some instances, vertigo, inability to stand, singing and other noises in the ear, and vomiting. The patient when the attack commences experiences the sensation of a rotatory movement, sometimes on a vertical and sometimes on a trans-

verse axis; that is to say, the patient feels as if falling forward or backward or as if he were being twirled around. There is usually more or less deafness at the time of the attack, which may become permanent. Tests with tuning-forks show loss or absence of bone-conduction. The symptoms of vertigo and rotatory movements are supposed to be due to lesions of the semicircular canals, while the deafness and tinnitus are undoubtedly caused by disease of the cochlea and cochlear nerve. Between the attacks the patient complains more or less of vertigo on moving the head or raising it suddenly from the pillow or when arising in the morning.

There are many cases observed in practice of patients suffering from vertigo, deafness, and tinnitus that suggest in a mild way Ménière's disease, and in such the disease is located in the middle ear, although the labyrinth is apt to be also affected.

For the **treatment** of Ménière's disease quinine has been recommended in doses of 8 to 10 grains a day, to be given for ten days or a fortnight. It is claimed that the symptoms, although aggravated at first, are very much diminished at the end of ten days. Immediately after an attack of severe vertigo the local abstraction of blood by means of the artificial leech will be of benefit in some cases, as well as the application of cold by means of the Leiter coil or ice-bag. Iodide of potassium in small doses should be given in some instances. Counter-irritation behind the ear over the mastoid should also be tried where other treatment has failed. The hypodermic injection of pilocarpine (6 to 8 drops of a 2 per cent. solution) three times a day is to be recommended in cases of Ménière's disease and in all cases of recent exudation in the labyrinth, more especially of syphilitic origin. Politzer was the first to advise the use of pilocarpine in such cases, and the prognosis of a case of inflammation and exudation of the labyrinth should not be considered unfavorably until the pilocarpine treatment has been tried for a period of six weeks at least. It is necessary to produce the full physiological effects of the remedy, and the dose, at first one-fifteenth or one-twelfth of a grain, should be gradually increased up to even one-fifth or one-third in some cases. The patient should be careful that he is covered up well when taking the drug, and he should not go out of doors for some time afterward. On account of its action on the heart great care should be taken in its administration, and it is well to have a stimulant at hand for fear of the heart's action becoming very weak. The best results are obtained in recent cases of syphilis of the labryinth, although I have seen improvement follow the use of this remedy in some cases of congenital syphilis.

In recent cases of syphilitic disease of the labyrinth I always begin the treatment by prescribing for some time bichloride of mercury and iodide of potassium, following these up at the end of a week or so with hypodermic injections of pilocarpine. Large doses of iodide of potash have been given with success by A. H. Buck in cases of congenital syphilis.

2. Boiler-maker's Deafness.—This is an affection of the auditory nerve, due undoubtedly to frequent and violent concussions. Such patients frequently complain of a distressing tinnitus, and tests with the tuning-fork show loss of bone-conduction.

3. DEAF-MUTISM.—Deaf-mutism may be congenital or acquired—*e. g.* due to some disease affecting the ear soon after birth. A baby brought to my observation a short time ago, although he had learned to say a few words, had gradually lost all power of speech and hearing. On close questioning the mother I found that the child had had a fall from the baby carriage some months previously.

It is impossible to test the hearing of small children, and in cases of supposed congenital deafness we must examine carefully the drum-heads, auditory canals, as well as the pharynx, nasopharynx, and tongue.

The causes of acquired deaf-mutism are scarlet and typhoid fevers, meningitis, measles, small-pox, whooping cough, scrofula, falls and blows, with resulting inflammation. Scrofula is undoubtedly an important factor in the causation of acquired deaf-mutism, and in that of the congenital form heredity, marriages of consanguinity, and syphilis play an important rôle, as well as drunkenness in parents.

FIG. 161.

Ear trumpet.

FIG. 162.

Conversation-tube.

The French system of instruction for the deaf consists in an artificial finger-alphabet, with a series of signs and gestures. Another system

is that in which the deaf-mute watches the movements of the lips, with all kinds of signs.

At the International Congress held at Milan in 1880 the unanimous conclusion was adopted that the pure oral or German method was the best, consisting in the employment of articulate speech and lip-reading.

Ear-trumpets.—Ear-trumpets of great variety have been devised—viz. japanned tin or iron, ebonite, or silver-plated trumpets. A tube with a horn tip for insertion in the external meatus (see Fig. 162) and a cone or cup attached to the other end, is one of the best for purposes of conversation. The audiphone of Rhodes and others has but a limited use.

SURGICAL DISEASES OF THE JAWS AND TEETH.

By LOUIS McLANE TIFFANY, M. D.

Anomalies of the Teeth.

Anomalies in teeth are seen very rarely in the deciduous set, but much more commonly in the permanent ones, and, while this does not hold in all cases, yet it is very generally true. The deciduous teeth number twenty, the permanent teeth thirty-two. Anomalies will be often found to accompany numerical changes in teeth, and should be looked for. It goes without saying that hereditary tendencies must not escape attention, and will be found to exist.

The teeth in excess of the usual number (supernumerary) may be similar to normal teeth or quite different. A deciduous tooth which remains in the gum long beyond the period when it should be shed must not be considered as a supernumerary tooth, all the other teeth being

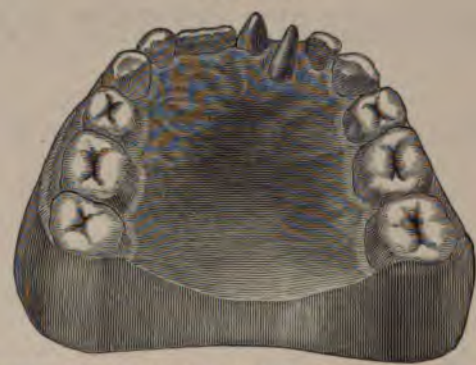
Fig. 163.

Supernumerary incisor teeth (Guilford).

of the second set, thus making the number greater than should be. Supernumerary teeth most commonly represent the incisors, and they may occupy a position behind or between the normal teeth; probably they will be found more often in the second row. Their time of eruption is usually coincident with that of the normal teeth. Teeth dissimilar

from the normal are usually small and conical in shape, and are placed between the normal teeth or replace an absent one. They have rarely long roots, and here also the front of the jaw is their chosen location. The expediency of their removal should be considered, but no definite

FIG. 164.

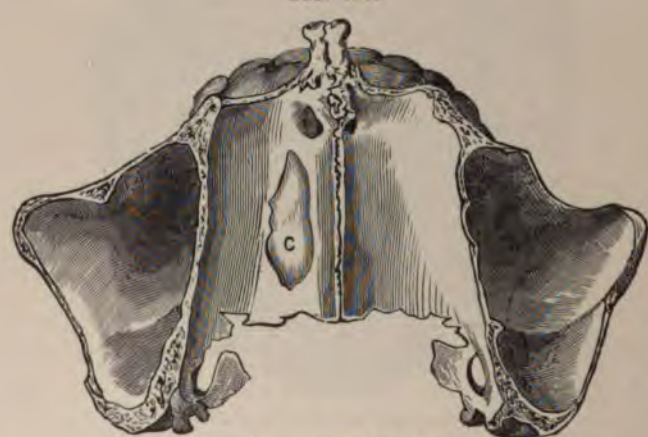


Supernumerary tooth causing torsion of one central incisor (Guilford).

rule can be laid down. If they interfere with the normal teeth, then they should be removed; but if not, then it becomes a question as to whether after removal the normal teeth which they replace will erupt at all. It would be probably better, in the absence of a specific indication, to keep the crown of such a tooth suitably capped and allow it to remain.

The teeth may be less in number than normal, and the question will present itself whether the lacking teeth have not already been extracted

FIG. 165.



Forget's case of misplaced cuspid.

or lost by some accident, for the testimony of a patient is not always to be relied upon. Again, a tooth may be misplaced in the jaw and be growing, but not where expected, and the discovery be made only later in life. It is of interest to note, in this connection, that the portion of

bone attached to the septum of the nose in double hare-lip (intermaxillary bone), although greatly misplaced, contains the germs of four incisors.

Multiple Sets of Teeth.

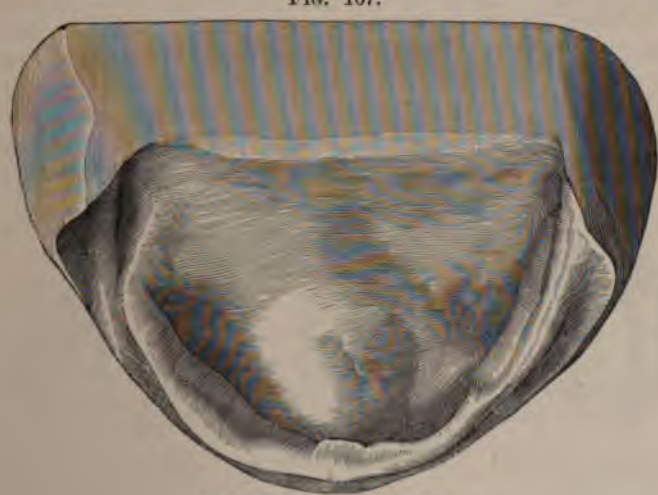
It is possible that more than two sets of teeth may appear successively, and it is very commonly spoken of, but evidence in support of

Fig. 166.

Edentulous jaw, upper (Guilford).

such hearsay is usually wanting. In the *Southern Dental Journal*, October, 1886, Dr. Catching reports what appears to be an authentic case.

Fig. 167.



Edentulous jaw, lower (Guilford).

Absence of teeth through life is extremely rare. Guilford, in the *Dental Cosmos* of March, 1883, reports a remarkable case in which the deformity occurred in three generations.

Malposition of one or both sets of teeth is of interest, more particularly to the dentist, with whom the correction properly lies. Hence it is not necessary to speak more of it here. Imprisoned or misplaced teeth have been already referred to, and directly concern the surgeon. The misplacement is a congenital condition, and the tooth grows often in perfect shape, yet in the wrong direction, and gives rise to various forms of disturbance dependent on the tissues against which it impinges. Such a tooth may cause a tumor concerning which the surgeon is consulted, and it requires removal. Forget relates a notable case which is herewith represented. I have removed from the nasal process of the right upper jaw a canine tooth which was lacking in its proper situation. Cysts may occasionally appear from the presence of such teeth. In the three or four cases of this affection that it has been my fortune to see, the situation of the misplaced tooth was not filled, and thus a clue to the condition of affairs was afforded. Giant teeth are sometimes met with, single or in pairs. When these are incisors the roots are usually small, and small wisdom teeth are not very rare. United teeth are encountered which result from the fusion of two adjacent germs, and such fusion will be partial or complete—complete when both root and crown are joined, partial when either crowns or roots are alone joined. By some peculiarity of the germ the tooth may be erupted with a crown distorted or with flexed roots, and of the latter condition the wisdom teeth furnish the most frequent examples. In the same way the roots may occur in excess or in diminished number. The presence of teeth at birth is not so unusual as to call for notice here.

FIG. 168.

Misplaced and imprisoned tooth (Forget).

FIG. 169.

Large central incisors (Coleman's Dental Surgery).

FIG. 170.

Fusion of lateral incisor and cuspid (Litch).

FIG. 171.

Fusion of molars (Litch).

FIG. 172.

Fusions of crowns of second and third molars (Litch).

Toothache.

Toothache is a symptom, and not a disease; hence its proper treatment consists in finding the cause and removing it. Probably the most frequent cause is caries, the sensitive pulp being exposed; this is very frequent in children. Inflammation more or less acute at the root of a tooth (commencing alveolar abscess) will induce it. In adults a recession of the gum, leaving a portion of the tooth exposed above the enamel, is followed by toothache. A growth at the root of the tooth may give rise to pain; this is very rare. In a number of so-called toothaches met with in aged people the trouble is due to an affection of the fifth nerve, and there is no trouble in the teeth at all. It is usual

Fig. 173. Fig. 174.

Tooth showing flexed root (Litch).

for patients with facial neuralgia to have many teeth extracted, hoping to obtain relief from pain, which, it is needless to say, continues. The pain of toothache is more or less intense, and may extend along the line of the sensory nerve; if due to inflammation, a recumbent position aggravates the pain. Where the pulp of the tooth is exposed by caries a solution of cocaine applied on absorbent cotton will be serviceable in obtaining relief, but a dentist should be at once sought.

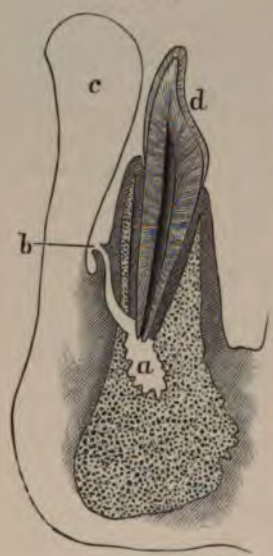
Gross has described a form of neuralgia in edentulous elderly people where, topical applications failing, removal of the alveolar border of the jaw has been followed by recovery. It has not been my fortune to see such a condition of affairs, but it is a question whether the relief obtained has not been the result of nerve-excision, for of course in an edentulous person the alveolar border has already been absorbed.

Alveolar Abscess.

Alveolar abscess follows inflammation occurring in the connective-tissue space at the apex of the root of a tooth. It follows the ordinary course of an inflammation; extends by absorption of the cancellated tissue of the jaw in the direction of least resistance, the pus burrowing toward the cheek surface of the jaw rather than toward the tongue; it may perforate the bone or make its way up the side of the tooth into the mouth. "Gum-boil" is the ordinary name for the affection. Occasionally the pus will burrow toward the skin, passing below the reflection of the mucous membrane from the cheek to the jaw. The pain is extraordinarily great, and does not bear direct relation to the amount of pus being formed. The tooth will appear to be lengthened; it doubtless is pressed somewhat out of its socket, and pressure upon the

apex causes pain. Tapping lightly on the apex of the tooth will give rise to pain. The gum becomes much swollen in that direction toward which the pus makes its way. Swelling of the face will also appear, especially if the formation of pus is large. The excessive pain felt by the patient is due to the fact that the inflammation is confined within bony walls; hence when the pus perforates or discharges into the connective tissue of the cheek the sensation of relief is great, but the pain will be renewed to a certain degree if the pus continues to be formed in the tissue of the face. A chill will be noted if the inflammatory process is severe. If alveolar abscess occurs at the root of the posterior molar, interference with the motion of the jaw may occur by direct extension of inflammation toward the joint, but more likely by implication of the muscles—masseter, pterygoid. Ordinarily an alveolar abscess after opening discharges for a day or two and then heals. If the amount of pus is large, the discharge may become chronic, and the bone will require treatment before the cure is complete. Very rarely burrowing of pus as a result of alveolar abscess takes place under the roof of the mouth or in the soft palate.

FIG. 175.



Chronic alveolar abscess at the root of a lower incisor: *a*, abscess-cavity in the bone; *b*, fistula discharging on the gum, *c*, lip; *d*, tooth (Litch).

Simulating an alveolar abscess, but more difficult to heal, are the inflammation and suppuration which result from the presence of a misplaced tooth, a wisdom tooth usually. The diagnosis of this condition is generally referred to the surgeon after several attacks of inflammation; the surgeon chisels away the enclosing bone and finds the cause of the trouble. Persistent inflammation, causing great hypertrophy of the lower jaw, is seen and has been considered a bony tumor requiring operation. The lower jaw in a case falling under my observation was an inch and a half in diameter and the thickening extended so near to the condyle as to seriously impair motion. The same involvement might happen with the upper jaw, although it is not so probable. In such a case, the trouble being removed, the jaw may be expected to return to its normal size. Injuries of the jaws of any kind characterized by inflammation render it probable that a surgeon will be called upon to give an opinion as to the necessity of an operation for the purpose of restoring the symmetry of the face. It is needless to say that the removal of the cause of the inflammation may be confidently expected to be followed by the restoration of shape.

ANTRUM.—The antrum. a pyramidal-shaped cavity of variable size, is situated entirely within the upper jaw. Its apex is toward the malar bone, and its boundaries are the floor of the orbit and roof of the mouth; the front and back walls of the jaw are its limits toward the face and pharynx, while its base is toward the nose, into the middle meatus of which it opens. The possible fluid contents of the antrum will vary

from one drachm to seven or eight, the average being three drachms. It is lined with mucous membrane, containing, of course, glands. In childhood it is very small. When absorption of the alveolar border of the jaw takes place it fills nearly the whole bone. The sockets of certain teeth project into it, those of the second molar especially. Enlargement

FIG. 176.

Alveolar abscess at the buccal roots of an upper molar discharging on the face: *a*, abscess-cavity in the bone; *b*, fistula opening on the face; *c*, maxillary sinus; *d*, nostril; *e*, tooth; *f*, fissure of cheek (Litch).

FIG. 177.

Scar caused by alveolar abscess discharging on the face (Litch).

of the antrum may take place possibly from retained secretion, but certainly from cyst-formation, a solid tumor, or inflammation; and from the relation which the cavity bears to the face generally it will be understood how distortion of adjacent parts may occur. Inflammation may extend to the antrum from the socket of a tooth, from the nose as a re-

FIG. 178.

Fistula passing down through the body of the lower maxilla (Black).

sult of the presence of a foreign body, from the presence of cryptogamic growth, or from injury with subsequent infection. The symptoms of suppuration vary in degree as the cavity remains closed or discharges freely into the nose; there will be a sense of weight, oppression, pain, and discomfort in the region of the upper jaw. The discharge

into the nose is continuous or intermittent according as the swelling of the mucous membrane does or does not close the aperture. By inclining the head to one side the discharge may increase, or there may be a sudden increase while lying down, sometimes accompanied by a bad taste and some odor. This is apt to be noticed in the morning after a night's rest, and the inference of course is that while sleeping the discharge has collected in the antrum. If the trouble has resulted from the extension of inflammation from the root of a tooth, or from the nose, or from injury and infection, there will be a corresponding history. Where the opening of the nose is closed from any cause the usual symptoms of retained pus will be present—pain, swelling, throbbing, fever, etc., and perhaps redness and œdema of the corresponding cheek. If the retention is great, protrusion of the eye is noted. Pressure on the second division of the fifth nerve can occur, with corresponding pain in the territory to which the nerve is distributed. The distention may be so great as to produce thinning of the walls of the antrum, allowing crackling on pressure, but I have never seen this except in the case of a soft tumor. It is mentioned as a classical symptom. Sudden discharge of pus may occur either into the nose or through the socket of a tooth, with marked diminution of pressure-symptoms.

The indications for **treatment** where pus is retained are plain: an opening is called for. Inasmuch as the sockets of certain teeth protrude into the antrum, an easy way out for the products of inflammation is afforded by extracting a tooth and then passing a trocar along the socket into the antrum; this opens the bottom of the cavity, but has the disadvantage of permitting pieces of food to pass upward. If the tooth is destroyed and extraction is necessary, of course it can be done, but it is probably better to enter a trocar just above the alveolar border, between the first and second molars, and so obtain free drainage without the same danger of food entering the antrum. The cavity should be washed out frequently. Usually the opening in the nose will become patent as the swelling of the mucous membrane subsides; if necessary it can be enlarged. The inflammation of the antrum will then no longer be acute, but a chronic antrum-empyema with one or two openings will exist. Antiseptics are indicated, and an investigation by culture should be made in order to determine whether other than the ordinary pyogenic bacteria are present. It is very exceptional to find general inflammation of the antrum mucous membrane persisting, but there may be present a condition analogous to that in the chest which calls for excision of several ribs, and the antrum has bony walls. I can quite understand that removal of some portion of the antrum-wall may be required to permit the opposite surfaces to heal, but such a condition of affairs has never fallen under my observation.

Dropsy.—The so-called dropsy of the antrum is not a simple retention of the secretion from closure of the opening into the nose, but is a cystic formation of a mucous gland, a dentigerous cyst, dermoid cyst, etc. In the latter case cholesterine is present. The contents of these cysts will vary; usually it is a gelatinous fluid more or less thick and more or less discolored. The amount of distention will be, of course, uncertain, and the first which is apparent will be forward and upward. The roof of the mouth will not give way, and the posterior surface of the

antrum will project into the pharynx. The nose will not usually be closed; and this is an important diagnostic sign between solid and fluid tumors; in the former case protrusion into the nostril is often met with. The diagnosis is uncertain without a digital examination, which should not be withheld, and an exploratory incision at the reflection of the mucous membrane from the upper jaw to the lip should be made, and a finger passed into the antrum; there will then be recognized the character of the secretion, the amount of distortion, whether the tumor is solid or not, especially the presence of a tooth or a growth from the root of a tooth which has projected into the antrum. The necessity for removing the lining membrane of the cyst is generally recognized, and the cavity must have frequent washings and injections with tincture of iodine, which is the best agent. Other astringents may be made use of later. I can conceive of a tubercular infection of the antrum requiring iodoform, but such an instance has not fallen under my notice. There is a form of epithelioma which occurs in the antrum as a primary growth. It is very insidious, and is recognized only by the patient when it has attained unusual dimensions so as to encroach upon neighboring parts. The "épitheliome térébrant" commences more often on the floor of the antrum than elsewhere. The patient's attention is first called to it by a little secretion which runs from that side of the nose; a faint odor may be detected. It perforates the wall of the antrum and appears as a growth outside; if downward, it appears as a wart in the roof of the mouth, and this may be noted even before the roof of the mouth is perforated; sooner or later the antrum becomes filled by the growth, and then the deformity ordinarily seen when the antrum is over-distended is noticed. If the antrum is perforated toward the face, the cheek of course protrudes. The diagnosis early in this disease is very difficult, owing to the lack of marked symptoms. A digital examination of the growth in the antrum and a microscopic examination of removed fragments make certain that which could only be surmised before. Glands beneath the angle of the jaw are involved in the latter stage of the affection, and only then.

The **treatment** is that proper for all epitheliomata—*i. e.* complete removal, together with adjacent parts, including lymphatic glands. The removal of the latter should not be discretionary with the surgeon.

Sutton records and figures a neuroma of the infraorbital nerve which invaded the antrum; it was covered by mucous membrane and was extremely painful.

Fractures of the Upper Jaw.

Fracture of the upper jaw results usually from direct violence, but may happen from a fall upon the chin, forcing the lower jaw so violently against the upper that the latter is broken. Fracture of the upper jaw is usually compound, through the sockets of the teeth or one of the many cavities in relation to the bone, nose, mouth, and antrum. There is no special direction along which the line of fracture seems apt to extend: it depends upon the amount and direction of violence, and is always irregular. Great tearing and laceration of the face may accompany these fractures, particularly as the result of a gunshot injury.

It is necessary to remember that the jaw, except the alveolar border, is made of thin plates of bone covered on either side by the periosteum, and if on one side this membrane is removed, that which covers the other side is sufficient to afford nutrition; hence necrosis after fracture is very, very rare, and is not to be expected except in those cases where powder-burn is added to other violence—*e. g.* blasting and gunpowder at close range. I am unable to speak from experience regarding the effect of dynamite.

In a case in which I assisted my late colleague, Christopher Johnson, M. D., the patient had been struck full in the face by the walking-beam of a steamboat. It seemed as if the entire face as well as the upper jaw was broken into many fragments, so that the face rose and fell in respiration. Of course much inflammation followed, yet an unexpectedly good result without necrosis was attained.

The **diagnosis** of upper-jaw fracture is usually easy, direct inspection and touch through the mouth being possible; displacements, being remedied, do not usually recur. Loose teeth and fragments must not be removed; this is a rule absolute: they should be restored to their natural position and retained there by proper apparatus. A tendency of teeth to become displaced downward will be corrected by use of the lower jaw as a splint, provided it will suffice; if not, then an interdental splint, which will be referred to later, should be used. Should there be very great comminution, as in the case already referred to, the jaw may be held up by wires passed through the cheeks and tied over the top of the head, and a properly shaped plate of vulcanite will in such cases be necessary under the jaw. Liquid nourishment will be required for a few days, and great cleanliness by frequent warm-water irrigations is imperative. Loose teeth and fragments of bone rapidly become firm in their proper position.

Fractures of the Lower Jaw.

Fracture of the lower jaw is met with more often than that of any other of the face bones. It occurs more often in men than in women and children, and during the period of active life between the years of twenty and forty more often than in children and those in old age.

The fracture is single or multiple, the latter being in one-half of the bone, or, as is more often met with, on each side of the middle line. The line of fracture may pass through the bone, or not entirely through the lower border, in which case a portion of the alveolus only is broken off. This is not an unknown accident in extracting teeth, and is probably the most frequent form of lower-jaw fracture. The median line of the bone is rarely broken, but the majority of fractures are in the neighborhood of the chin; perhaps the neighborhood of the lateral incisor and canine tooth is the chosen seat of fracture. Thus it appears that the body of the bone is more often broken than the ramus or neck. The line of fracture is rarely vertical, almost always diagonal; diagonal also in the thickness of the bone, the anterior surface and the posterior surface being broken at different levels; hence the edge is sharp and displacement not difficult.

Fracture of the body of the bone, owing to the sockets of the teeth,

is perhaps always compound, yet this does not seem to interfere with good union, nor does inflammation follow, as would be expected to occur elsewhere in the body from a compound fracture. This is the more interesting when it is remembered that the mouth is often the seat of an inflammation producing bacillus (diplococcus lanceolatus), and the compound fracture is bathed in saliva which habitually contains other organisms than the one referred to.

The dental nerve, lying in its canal, does not seem to suffer as might be expected when a fracture of the body of the bone has taken place. Pain, such as would be expected to follow the pressure of broken bone on a sensitive nerve, is not complained of. Again, the pain which might be expected to result from injury to the nerve at the seat of fracture is not referred to the teeth anterior to the injury. Anæsthesia of the chin may be noted, but pain in the chin does not occur. When double fracture happens in the body of the bone on opposite sides of the middle line, the intervening portion of bone carrying with it the tongue, attached to the genial tubercles, falls downward and backward, and the patient is in danger of suffocation: this result can be obviated by grasping the tongue and pulling it forward, but to prevent the return of the same the bones should be promptly wired in position.

Some years since a patient who had sustained this injury thirty hours before coming in my care had been able to breathe only by lying on his face with the tongue well pulled forward: I saw him in this position, and after wiring the fragments he was able to assume any position desired.

Direct violence is the usual cause of fracture, the bone breaking where struck; indirect violence exceptionally is noted when, for instance, a wagon-wheel passes over one side of the jaw and fracture takes place close to the middle line.

Fracture of the ramus of the jaw behind the teeth is rare, and results from direct violence. There seems to be no special direction for the line of fracture to follow. It is to be remembered that the masseter here acts as a very good splint and displacement is usually not great. Fracture at the neck of the condyle is a rare injury, and may result from a direct blow, but probably more often results from a blow upon the chin. The condyle will be drawn forward and inward by the pterygoid muscle, and will lie in front of the articular eminence near the foramen ovale. Crepitus will not be obtained, probably, even by pulling the jaw well forward.

Fracture of the coronoid process, if it ever happens, will escape detection. Recognition of fracture of the lower jaw is usually easy. The history of the injury, pain, loss of function, displacement, as noted from the position of the teeth and by examination with the fingers within and without the mouth, undue mobility, recognized in the same way, will suffice to make the diagnosis plain.

Where there is multiple fracture the diagnosis is still more easy. In fracture of the neck of the condyle the chin will be carried to the injured side. There will be no difficulty in opening the jaw, and a depression may be recognized in front of the ear; crepitus, often present in jaw-fracture, is here wanting.

Treatment of Lower-jaw Fractures.—Displacement of fragments after fracture is usually not great, hence replacement is easy, but a

tendency to recurrence of deformity is often marked. It may happen that interlocking of the fractured surfaces has occurred, so that restoring the arch of the bone is difficult, and it may even occur that the muscles attached to the lower jaw in the vicinity of the fracture may require division. After adjusting the fragments in proper position, little save quiet may be required in order to obtain a satisfactory cure, and in such cases almost any form of bandage that holds the jaw at rest will suffice —a four-tailed bandage or any other. Sometimes it may be wise to make a pasteboard cup which receives the chin, and the bandage passes over it and the top of the head. If the upper teeth are present and in good order, they will act as a splint and will assist in retaining the form of the lower jaw. In some cases—fortunately, the minority—displacement returns quickly after the fragments have been adjusted, and it becomes necessary to use one of the forms of splint which have been found serviceable under similar conditions. It is my habit always to call in consultation a skilled dentist, and with him fit and adjust a proper splint—an interdental splint of vulcanite, or Kingsley's, Moon's, Gorgas's, etc. In order that the dentist may obtain a good impression of the fractured jaw, it is necessary that the fragments should be held in apposition, and this may be done by wiring or tieing the adjacent teeth so that a temporary restoration of the arch is obtained. Inasmuch as fracture of the lower jaw is so often compound into the tooth-sockets, I have never hesitated in cases of difficult retention of fragments to wire together the different portions of the jaw, and in no case have I regretted it.

When there is a wound of the lip or cheek such an operation is easy. When there is no wound, and the operation cannot be done through the mouth, an incision beneath the chin or the body of the bone gives access to the broken surfaces, and the line of incision is out of sight. I do not leave the wires in permanently, but remove them when they have done their duty.

FIG. 179

Kingsley's splint applied.

Under the head of Fractures of the Upper Jaw reference was made to interdental splints, which of course are applicable to one jaw as well as the other. Attention must be called to the fact that when consolidation of the bone is complete the dentist, in some cases, will be required to adapt an artificial denture, and, even if the appearance of the restored jaw is not satisfactory, with the assistance of the dentist the result may be excellent.

In fracture of the neck of the bone, the condyle being drawn forward, as has already been noted, accurate replacement of the fragments is not possible and a false joint will remain. The condyle will become adherent in its false position. Pseudo-arthrosis or delayed union in the body of the bone or ramus is very rare. Perhaps a seton passed be-

tween the fragments will be effective in exciting proper repair; if not, it will be right to expose the line of fracture, re-fresh it, wire it, and thus bring about union. Great swelling and salivation follow fracture of the jaw. Copious warm-water irrigation will not only give comfort, but will keep the mouth clean. The patient is to be nourished by soft

FIG. 180.

Kingsley's splint (Stimson).

food until the jaw is sufficiently strong to permit mastication to be resumed.

GUNSHOT FRACTURES OF THE JAWS.

Gunshot fractures of the jaws present three points worthy of note: 1. A missile may lodge in the upper jaw and escape observation for a long period. Dr. Fraser[1] records a fragment of metal three inches long which so lodged; a model is in the museum of Guy's Hospital of a piece of the breech of a gun which remained for more than twenty years in the right upper jaw. 2. Secondary hemorrhage has been repeatedly observed when the bullet after perforating the jaw has entered the neck. 3. After the immediate effect of an injury has been recovered from, the services of a skilled dental surgeon will be required to properly restore the teeth and the dental arch by means of appropriate prosthetic apparatus. The great deformation undergone by the soft leaden bullet has probably had much to do with this accident, and is not to be expected with the modern jacketed missile, at all events to the same extent.

FRACTURED TEETH.

Fractured teeth are of course the result of great violence, and should be considered in regard to crown and root, whether one or both suffer injury. Such cases are so distinctly in the way of dental surgery that it is not necessary here to speak of treatment. The possibility of a longitudinal fracture of the root of the tooth may be called in question. I think it can be accepted as a fact that such does occur, but not often.

DISLOCATION OF THE LOWER JAW.

Dislocations of the lower jaw are comparatively rare, and may be either bilateral or unilateral. Dislocation backward occurs only with fracture into the auditory canal. The violence is received from before backward, such as would be produced by a fall on the chin. If the direction of

[1] *Edin. Med. Journ.*, Sept., 1856.

the force is somewhat upward, the condyle may go through the base of the skull. Displacement of the condyle from its normal position, pain, immobility of the jaw, bleeding from the ear, and a recession of the lower teeth suffice for a diagnosis. If the displacement is unilateral, the chin will be turned to the side of the dislocation.

Lateral dislocation only occurs with fracture of bone. Such cases are the result of great violence—a fall from a height, for instance, the passage of a wagon-wheel over the face, etc.

Dislocation forward is much the most common form, and may occur on either one or both sides. It may occur from muscular action alone, as in shouting, laughing, loud talking, etc., also by violence applied on the outside of the jaw and from behind. Unskilful attempts to extract a molar tooth have produced unilateral dislocation. A case has been reported of dislocation during sleep. Dislocation may occur at any age, and is more often observed in the female than in the male. To understand the dislocation the anatomy of the joint must be called to mind. Symptoms of bilateral dislocation are: The mouth is open and held immovably so; swallowing is impossible; saliva flows from the mouth; the pain usually is great and the patient has a look of extreme distress; the condyles are absent from their normal position; the cheeks flattened, and the masseters tense. If the dislocation is on one side only, the chin will be turned to the opposite side, and the teeth will not normally coapt, but there will be less pain than if the dislocation were bilateral. To reduce, it is only necessary to press the condyle downward below the articular eminence, and the temporal muscle draws it back into position at once, closing the jaws with a snap and biting anything that may be between them; hence the thumbs may be caught between the teeth, and should be wrapped with a bandage to avoid injury. Reduction is effected thus: The patient (anæsthesia is not necessary) is seated on a low chair, resting the head against the wall in erect position; the surgeon, standing in front of the patient, passes his thumbs, lightly wrapped with muslin to avoid injury, into the patient's mouth in such a manner that they rest on the crowns of the posterior teeth, the fingers grasp under the angles of the jaw. The surgeon now presses with his thumbs downward and perhaps a little forward to disengage the condyles, and then downward and backward. Usually the patient attempts to rise from his seat, thereby aiding the surgeon; the jaw slips backward and the dislocation is reduced.

The jaw, having been dislocated once, is liable to suffer a repetition of the accident, and it may become a very frequent occurrence. Patients learn to reduce the dislocation themselves. I have known it to happen twice within an hour and three times within a day to one patient.

Annandale has successfully treated cases of frequently recurring dislocation by opening and suturing in position the interarticular fibro-cartilage. R. W. Smith reports a case of congenital malformation of the condyle, and therefrom resulting dislocation.

Hypertrophy of the Neck of the Condyle.

A few cases have occurred where overgrowth of one ramus of the lower jaw and neck of the condyle has taken place. The cause of the

affection is not known: it results in the failure of teeth which should oppose each other to coapt, and the chin is thrust away from the side which is enlarged. It might be looked upon as a form of rheumatic arthritis accompanied by overgrowth, and if seen in its incipiency and the diagnosis made, mercury and the iodides, with perhaps blistering, could be resorted to. After the deformity has taken place medical treatment is of no avail. Excision of so much of the hypertrophied neck and ramus as will allow the bone to resume its natural position, the bones being wired together so as to obtain union, is the proper procedure.

Diseases of the Temporo-maxillary Articulation.

The temporo-maxillary articulation, while subject to the same diseases as are the other joints of the body, is, fortunately, very rarely affected. Tuberculous, syphilitic, and inflammatory disease, the latter following injury, is recorded, but need not be considered as different from other joint troubles. Two or three times it has been my fortune to meet with apparent roughness with soft grating present in the joint, yet little pain. Upon a mixed treatment of mercury and iodide the noise in the joint disappeared and the joint returned to the normal condition. Astley Cooper has described a subluxation of the temporo-maxillary joint, but I cannot say that I have ever been able to recognize the disease as described by him. Heath believed the trouble to be of a rheumatic or gouty nature, and with this opinion I am rather in accord.

Ankylosis of the Jaws.

Ankylosis of the jaws is met with as a symptom of several conditions, such as inflammation in the neighborhood of the masseter muscle, or, still nearer, the articulation as an accompaniment of abscess and necrosis of the lower jaw; or a growth near the ramus, causing pressure without inflammation; exudation will of course limit motion, which limitation of motion may be confidently expected to disappear when the inflammatory condition which has given rise to it has ceased to exist. After an extensive inflammation with exudation restoration of motion is often slow. Spasm of the masseter muscle, limiting motion, has been noted not infrequently as a result of defective eruption of the wisdom tooth of the same side, and may last a long time. It may happen that the crown of the wisdom tooth is turned in the wrong direction, or there is not room for the tooth to erupt, the adjacent tooth interfering with it. Or, again, it may happen that the slowly-growing wisdom tooth has imperfectly come through the gum. The presence of the wisdom tooth may set up inflammation in the gum with formation of pus and extensive burrowing, sinuses in the neck, etc. The inability to open the jaws will render a diagnosis all the more difficult. Anæsthesia is expedient. The patient being under the influence of an anæsthetic, the mouth can be opened, forcibly, if necessary, and the condition of the wisdom tooth attended to, either by extracting it or by extracting the next tooth, so as to allow it to erupt properly. If the crown of the tooth be turned in the wrong direction, it will be necessary to chisel away the alveolar border before the tooth can be removed. The most frequent and the most

intractable case of ankylosis occurs where the cheek has sloughed and is replaced by scar-tissue which binds together the jaws. The cicatricial bands passing from alveolar border to alveolar border hold the teeth firmly together, and often distort them by gradually increasing pressure (cicatricial contraction). It will be found usually that some of the teeth have become carious, and tooth-ache is a not uncommon accompaniment of the trouble. The firmness and extent of the scar-tissue will vary. It will be found usually to extend more toward the back than toward the front of the jaw, opposite the molar and bicuspids. The cause of the sloughing of the cheek may be noma or the eruptive fevers, but especially the administration of mercury is believed to give rise to it. It is said by those capable of judging that ankylosis of the jaws from cicatricial bands is not so often seen now since the use of mercury is less common. Hence excessive salivation is charged with being a frequent cause. Cases have fallen under my observation that have attributed their deformity to severe salivation followed by sloughing. The result of the formation of cicatricial bands producing ankylosis in children differs markedly from that of the same condition in the adult, inasmuch as the growth of the lower jaw in the former is retarded, while in the latter it is not. The younger the child the subject of this trouble, the more undeveloped will be the jaw and the greater will be the deformity later in life. If jaw ankylosis occur in very early childhood, the chin will be almost wanting when adult life is attained, and the appearance in a woman, who cannot conceal the deformity with a beard, is not attractive.

FIG. 181.

Perforation of cheek from mercurial stomatitis, with cicatricial adhesion.

The **diagnosis** offers no difficulty. Inspection, inability of the patient to separate the jaws, and examination by the finger are sufficient.

Treatment is commenced by division of the cicatricial bands, but division followed by stretching will be promptly followed by re-formation of the bands of scar-tissue. Sometimes in such cases the mouth is forced open by pressure on the crowns of the teeth, but the teeth become distorted very quickly if such an attempt is made. Where it is required to make pressure on the crowns of the teeth—and it is only to be done in very simple cases—silver caps are to be made for the teeth of both the upper and lower jaws, so that pressure cannot distort them. To make often or to continue for a long time such pressure is very unwise. What is required is that the scar-tissue shall be taken away and replaced by normal tissue, either by transplanting mucous membrane from an adjacent part of the mouth or by taking skin from an adjacent part of the body and thus replacing the removed scar-tissue. In some cases grafts by the method of Thiersch can be made satisfactorily. In order

that this shall succeed the cheek will have to be divided, turned up and down, and secured until the skin-graft shall have become adherent, after which the divided cheek can be united again. Taking the mucous lining from the cheek of an animal and using this to do service as mucous membrane in the mouth of the patient can be attempted with advantage. I have succeeded in filling up a gap corresponding to the loss of a whole cheek nearly, by taking a flap of skin from the patient's neck and back and turning it on to the face, the pedicle being divided when the flap had grown firmly in position (Fig. 182). A flap from the arm could be utilized in some cases, but I have had no experience with this method. One or the other of the artifices just referred to or a combination of several will usually suffice to restore motion where ankylosis exists, but the line of incision and procedure to be followed must be chosen by the operator, and rigid rules cannot be laid down here.

FIG. 182.

Slough of cheek, opening mouth, from caustic used by cancer-curer.

Rizzoli and Esmarch have suggested division of the lower jaw for ankylosis. Rizzoli cuts through the bone from within the mouth without skin-incision. Esmarch by open incision beneath the jaw excises a piece of bone a quarter to a half inch in length entirely through the jaw, and by motion prevents bony union. Of the two methods, Esmarch's is the best. Both operators divide the jaw anterior to the binding cicatrices. Esmarch's operation is less likely than Rizzoli's to be followed by union and recurrence of ankylosis. It of course leaves the ramus and posterior portion of the body unmoved, but it restores the opening and shutting of the mouth, and is a good operation. I know of no method of increasing the size of a lower jaw which has failed to develop during childhood. Excision of the condyle can be resorted to with advantage in cases where adhesion between the jaw and the socket has taken place.

NECROSIS.

Necrosis is met with as an affection of either jaw, but more frequently in the lower. The alveolar border, the body, the ramus, or all may be involved. Necrosis of the alveolar border of the upper jaw in the middle line, involving two or three teeth on either side, is rarely seen except as an indication of congenital syphilis: I have seen it as late as the age of sixteen or seventeen years. The roof of the mouth immediately behind the alveolar border is involved, usually to a small extent, in the process. Perforation of the hard palate is considered an evidence of syphilis. In the lower jaw necrosis is seen following an acute osteo-

myelitis, as is found elsewhere in the body. In view of the many pathogenic organisms existing in the mouth, this need not excite wonder, yet it still remains to be explained why the lower is so much more often attacked than the upper jaw. The most likely cause is found in the fact that the lower jaw is anatomically a long bone, in which class of bones osteomyelitis is very apt to occur, while the upper jaw is largely made up of plates of bone. We know, furthermore, that operations involving the floor of the mouth are more fatal than similar operations on the roof of the mouth. A sequestrum surrounded by new bone is met with in necrosis of lower jaw, but very, very rarely in the upper jaw. The articular extremities are very exceptionally involved, the body of the bone most often, the ramus less frequently. Following the eruptive fevers, necrosis may occur in either jaw, the alveolar border being involved, and this may occur symmetrically.

Noma, seen in ill-nourished, feeble children, affects primarily the cheek, and secondarily the gums and bones. It follows no regular course. Traumatism acts here, as in other parts of the skeleton, as an exciting cause of osteomyelitis. The exhibition of mercury in excessive doses has been cited as a cause for necroses. It is to be remarked that mercury has been given in fevers, and it may be worth while considering whether the necrosis is a result of the fever or an osteomyelitis, or of mercury. I am of the opinion that in a certain number of cases an infective osteomyelitis is the cause of the trouble. At the present day necrosis of the jaws is much less often seen than in times gone by, when it was the habit to give large doses of mercury. The history of some cases seems to indicate that the death of the bone resulted from mercurialization. When mercury is the cause of the trouble it is not necessary that there should be bad teeth. Where there is phosphorus-necrosis, which was at one time so common with match-makers, the disease is necessarily preceded by a carious condition of the teeth. Scurvy is instanced as a cause of necrosis, but, thanks to the present hygienic conditions at sea, it is never seen. Inflammation of the lower jaw follows the same course as osteomyelitis elsewhere, and needs no special directions. The rapid onset of the disease, great swelling of the face, discoloration of the skin, inability to use the jaws, pain, high temperature, and rapid pulse, with fluctuation appearing soon, make a picture which is not to be mistaken, and to which may be added the speedy loosening of the teeth. Childhood and adolescence are the periods of life in which the disease is most often seen. The deciduous teeth fall out, and the germs of the permanent teeth may escape the inflammation sometimes. Permanent teeth, being destroyed, are not reproduced. Pus

FIG. 183.

Destruction of cheek, the result of cancrum oris.

forms early, and discharges into the mouth or through the skin, but more often the opening is in the mouth. Pain and swelling then diminish, and the separation of the destroyed pieces of bone follow as elsewhere in the body. If the opening takes place in the mouth, much of the discharge is swallowed necessarily, but this does not seem to produce the constitutional trouble which one might imagine. The pus coming from dead bone is apt to have an odor. An early incision, so as to give free opening into the mouth, is expedient; to avoid scar on the skin it is to be strongly urged. Such treatment will usually stop the disease; if not, it may be necessary to open the bone by chisel, etc. freely. Here an opening beneath the jaw is indicated. In the subsequent treatment the important thing is to preserve the shape of the lower jaw and thus avoid deformity. It is usually, if not always, unwise to take away necrosed bone by operation until an involucrum has formed which will retain the shape of the face. Extraction of the sequestrum, if done too early, may result in collapse of the fragments of the lower jaw, producing a radical change in the patient's appearance. Free opening, frequent washings, and fluid nourishment will carry the patient along comfortably until the dead bone is loosened and can be taken away without undue violence. While the flow of pus is great, marked symptoms of constitutional sepsis are rare. The subsequent history of the individual will show a gradual diminution in the size of the bone over the affected area, and the appearance of the face will appear more natural. Teeth-germs in the necrotic area die, but at the border of the dead bone germs of permanent teeth often escape destruction, and erupt after the sequestrum is removed; along the edentulous line a firm, strong bone is reproduced which can perfectly well carry an artificial denture. Sinuses may form in the neck giving exit to the pus; occasionally the external opening will be found as low as the clavicle; these are always to be regarded with anxiety, the white pasty face and rapid pulse seen in such cases are truly danger-signals. The phosphorus-necrosis already referred to commences insidiously at the seat of a carious tooth; the gums become swollen and livid, the teeth loose and black, and the gums no longer adhere to the alveolus. New bone, of mortar-like consistency, will be deposited on the sequestrum. It goes without saying that phosphorus-necrosis is a preventable disease, and the manufacturers of matches should require their employés to keep their teeth in good order or be discharged: there ought to be no exception to this rule, and the manufacturer should hold his employés to it. In all cases of jaw-necrosis the patient is to be supported by food both nourishing and digestible, and the treatment should include a proper amount of out-of-door exercise, exposure to sunlight, cleanliness, and the regulation of the functions of the body. The removal of sequestra is to be done through the mouth, so as to avoid the scar of an incision if possible. Where the sequestrum is very large and extends across the middle line at the symphysis, it may be well, and usually is well, to divide the dead bone and extract each portion by itself. Before doing this the operator must be very careful to see that the muscular attachments at the genial tubercles are replaced by a string passed through the tongue and held firmly, otherwise the tongue and the epiglottis fall backward and asphyxia becomes imminent. This makes it all the more important that the involucrum should have been

formed before the dead bone is taken away. By separating the periosteum with a proper instrument the bone will lie in a furrow and can be kept clean, and the muscular attachments become firm to the new bone before the dead one is taken away. It is worth while calling attention to the fact that where bone is loose in the upper jaw reproduction does not take place. A fibrous tissue is formed which does not ossify; in this respect a notable difference exists between the upper and lower jaws. The swelling of the face is very great, the inability to open and shut the mouth complete, pain extreme, and the condition of affairs is grave. Such cases, however, do well. If the mouth can be opened sufficiently to expose the point of inflammation, an opening should be made; if not, then near the angle of the jaw: the surgeon will thus be enabled to

FIG. 184.

Sequestrum following necrosis of lower jaw.

arrive at the seat of disease and by free opening give relief. It is, I think, here particularly important that the sequestrum should not be removed until new bone has formed, that the shape and function of the jaw may be preserved. It has not been my fortune in such a case to see an autopsy, and I do not know just what takes place in the joint after removal of the condyle; but I have more than once seen the condyle removed for necrosis in childhood, and a perfectly movable lower jaw be present when the child grew up.

ODONTOMA.

Odontoma is a term applied to a class of tumors originating in the teeth or germs of teeth, and composed of one or more of the teeth-constituents according as the growth of the enamel-organ, the follicle, or the papilla predominates. They will generally be found connected with the permanent teeth, the molar or canine teeth more often than others. An odontoma grows slowly in the jaw. At first the distended bone is firm and strong, but subsequently thin and parchment-like; perforation may take place at some point; then inflammation and suppuration occur,

which become chronic and clinically suggest necrosis. From the enamel-organ an outgrowth is rare. It takes the form of a multilocular cystic tumor, the compartments being of variable size; generally they will be not larger than one inch in diameter, and may communicate freely the one with the other. Sometimes the walls between the chambers will be ossified, sometimes not. The stroma of the tumor is colored reddish, and reddish-brown fluid fills the chambers. The cells lining the alveoli are columnar. Adolescence is the period of life when such tumors make their appearance; they are not considered malignant, and may exist for a long time without giving rise to uncomfortable symptoms: being the outgrowth from an epithelial surface, it is a question whether in and after middle life malignancy may not appear. From the tooth-follicle originates the dentigerous cyst. It offers for consideration walls and contents. The fluid within the cyst is thicker than water, and clear, unless an injury has been received, when it may be mixed with blood. A tooth or a portion of malformed tooth will usually lie within the cyst. The walls of the cyst vary, and are either of bone or fibrous tissue which here and there may be ossified or may be composed of cementum (cementoma). If the capsule is fibrous, it justifies the name of fibrous odontoma, and the contained tooth may never erupt. Calcareous matter will be present in the capsule. Sutton says they are frequently seen in animals, in goats especially. If the capsule irregularly ossifies, then such ossification may represent teeth. Quite a number of cases are reported. Thus, Tellander has reported a case where the teeth were wanting from the second molar to the lateral incisor of the right upper jaw, and replaced by a tumor which, being cut open, was found to contain a number of teeth.

Tomes has reported a somewhat similar case. It is believed that in the human being thickening of the capsules of the teeth may result from constitutional disease, rickets being credited as a cause, syphilis also. After the eruption of the crown of a tooth a tumor may form during the growth of the root: it bears the name "radical odontoma," and of course the crown of the tooth does not enter into the formation of such tumor. The growth will lie beneath the tooth, which has already erupted and is associated with it. Examples are rare in man, but not uncommon in rodents. When odontoma is composed of all the tooth-structures—papilla, follicle, and enamel-organ—it is called a composite odontoma. The three constituents are mixed together inextricably. A number of such cases are reported. The tumor may be large, and will of course displace adjacent parts; Hilton's well-known example probably grew in the antrum. Odontomata in their clinical aspect have much in common: they occur at the age of puberty and during the next ten years. They usually occur in that part of the jaw which contains the molars, bicuspids, and canines, and are at first covered by bone, which may subsequently become thin by distention and permit fluctuation to be recognized. Adjacent lymphatic glands are not affected save when suppuration is present. Pain is wanting, inflammatory symptoms are rare; there will be lacking one or more teeth from their usual positions, and this may give a clue to the character of the tumor present.

A diagnosis is rarely possible without a free opening and careful exploration of the tumor, and if there should be found a firm bony cap-

sule without tooth-structure, it does not mean that a tooth is not concealed within. Hence it is proper in tumors of the jaw to freely open by knife or chisel. An odontoma does not require excision of the jaw in order to effect a cure. Removal of the tumor itself is sufficient.

Hyperostosis.

Under the above name has been described by Howship, Cooper, and others a bony enlargement of the jaw which is well shown in the accompanying plate. It is characterized by an excessive deposit of new bone, filling the cavities of the normal bone and projecting outward as a dense mass. Other bones besides the jaws have been noted as being involved. The skull of a Peruvian is in the museum of the College of Surgeons, London (Heath), in which nearly all the bones of the face are affected. The right half of the jaw, for instance, is five inches in circumference. Unfortunately, no history is appended to the specimen. The appearance of the disease suggests that it was of a chronic inflammatory nature. In one or two instances thickening of the soft parts has coincidently taken place. Removal of the whole or a portion of the affected bone by chisel or mallet suggests itself as the most reasonable plan to be pursued if the diseased area is not too extensive.

Fig. 185.

Howship's case of hyperostosis.

Non-malignant Tumors of the Upper Jaw.

It is probable that non-malignant tumors of the jaws occur as in the osseous system elsewhere. There is no special reason why they should develop differently about the face. It is very likely that in the past odontomata have been described and figured as fibroid or cartilaginous, or perhaps bony, tumors. Fibroid tumors springing from the interior of the upper jaw are probably examples of that form of odontoma already mentioned. The fibroma most often seen is one originating in the periosteum at the border of the alveolus and known by the name of epulis, having its seat in the periosteum; the growth is of a rounded form, springing between two adjacent teeth and projecting toward the cheek. It extends toward the buccal side of the jaw rather than toward the lingual surface, and extends over a more or less large portion of the bone according to the time it has grown. It is covered by a healthy membrane which is the color of the gums. It rarely attains any great size. To the touch it is firm and elastic. The removal of the tumor itself without removal of the bone does not prevent recurrence. The sooner it is removed and the smaller it is, the less bone need be taken away. The two teeth from between which it springs are to be extracted, and the intervening bone—indeed, so much of the bone as is in relation to the tumor—is to be gnawed away by properly constructed forceps.

It is not at all unlikely that sarcoma of the jaw has been confounded with fibrous tumors (epulis) in the past. The recurrence of the fibrous tumor after removal is possible, but in such a case there will exist a doubt as to the accuracy of the diagnosis—that it may not have been a sarcoma.

Calcareous degeneration of a fibrous tumor of the upper jaw is possible, but the few cases reported as such were very likely examples of that form of jaw-tumor now known under the name of odontoma.

Enchondroma of the Jaw.

Enchondroma of the jaw, as elsewhere on bone, is met with as a slow-growing, hard, elastic tumor; it is described by Heath, who figures a patient's appearance. With our present knowledge, what has been said in the previous section in regard to tooth-tumors being confounded with cartilaginous tumors is true here. The more does this seem likely, inasmuch as fibrous and cartilaginous tumors have been not infrequently encapsulated, which is so very different from what is met with elsewhere in connection with the skeleton as to suggest a possible error in diagnosis.

Osteoma.

It occurs but rarely, such a tumor attaining a large size infrequently.

Fig. 186. Fig. 187.

Osteoma of upper jaw (from *Musée Dupuytren*).

Sarcoma of the Jaws.

Sarcoma of the jaw, while it follows the same course as sarcoma in other bones, and is histologically similar, offers more difficulty in diagnosis, for the jaws differ anatomically from the rest of the skeleton, inasmuch as teeth or teeth-germs exist, and in regard to malignant tumors of teeth-germs we are not as yet well informed; in addition to which the upper jaw contains a large cavity and is in immediate relation with the nose, orbit, mouth, and pharynx, into which a sarcoma may grow, and so obtain decided bulk before making itself apparent upon the external surface of the face or attracting the attention of its pos-

sessor. Sarcoma originating elsewhere—for instance, at the base of the skull, the nasal septum, etc.—is liable to be mistaken for tumor of the upper jaw, which it may advance toward and displace, thus simulating a growth originating in the bone itself. A protrusion of the meninges of the brain (meningocele) may be mistaken for an upper-jaw growth.

The lower jaw, containing no cavities and being subcutaneous, when the seat of sarcoma, behaves much like a long bone. Sarcoma of the upper jaw originates on the anterior surface exceptionally, on the palate very, very rarely, within the antrum frequently. When so situated it commences without pain, and by a gradual increase will encroach upon the adjacent cavities. Never is the hard palate pushed downward

FIG. 188.

Sarcoma of upper jaw (from patient in University Hospital).

FIG. 189.

Malignant tumor of both jaws (from patient in Presbyterian Eye and Ear Hospital).

by protrusion into the nose; extension into the temporal fossa is occasionally seen, and into the pharynx often, with closure of one nostril. Increase in size results in greater swelling of the face, which, with pressure into the orbit, is seen only when the tumor is large. If the growth is toward the nose, occlusion of the tear-duct may take place. When a sarcoma erodes and passes through an encasement of bone, its growth becomes rapid and is in the direction of least resistance; when the skin gives way, a fungous mass will protrude, and hemorrhage follows with sloughing and fetor. It has been my fortune to see one instance only of sarcoma of the hard palate; the growth had passed across the middle line. It was removed by taking away the greater part of both upper jaws, and at the end of two years had not returned. Sarcoma originating in the muco-periosteum, often improperly termed epulis, will grow toward the cheek and rapidly along the alveolar border; this is especially the case in the lower jaw, where a tumor will project downward and outward rather than inward; such sarcomata are spindle- or round-celled, or a mixture of both. Possibly the spindle-celled sarcomata may contain cartilage. Central sarcoma of the lower jaw may occur, and will probably be a myeloid, but it is more apt to be a malignant growth of

the tooth-follicle, which remains for a long time encapsulated, expanding the bone over it. I think that the majority of central tumors of the lower jaw originate in tooth-follicles. Such sarcomata are seen in children and commence in the molar portion of the jaw. Sarcoma of the ramus of the lower jaw projects backward into the parotid region. Involvement of the lymphatic glands secondary to sarcoma of either jaw is exceptional, unless ulceration of the growth has supervened. It is scarcely necessary to state that the most distressing forms of deformity and face-distortion result from jaw-sarcoma.

Traumatism in a number of cases is the exciting cause of sarcoma. The age at which the growth is seen most often is during the period of adolescence and early puberty, although exceptions are met with. The age of the patient, possibly the history of an injury, a solid growth, slow at first and subsequently rapid in its increase, advance in the direction of least resistance, and absence of pain, will go far toward justifying a diagnosis of sarcoma, but not entirely so. It is unquestionably right to freely open and examine by touch all jaw-tumors, and in addition an examination by the microscope will in many cases be not only expedient, but proper. A growth originating from a tooth-follicle, dentigerous cyst, or other odontoma, especially if covered by bone, may be mistaken for a malignant tumor, and subject the patient to a severe operation with great resulting deformity. It is my habit, therefore, always, before subjecting a patient to the removal of the jaw or a portion thereof, to assure myself of the accuracy of my diagnosis by freely cutting into the tumor and perhaps examining a section of the same by the microscope. It is only necessary to call attention to the fact that dentigerous cysts surrounded by bone will present to the examining finger quite as much resistance as a malignant tumor covered by bone. The safety of the patient is obtained by free removal, not only of the tumor itself, but of the surrounding tissues as well.

The prognosis is distinctly not good; recurrence often takes place, more often in the upper than in the lower jaw, the difference of result being, in all likelihood, owing to the anatomical peculiarities of the two bones.

Epithelioma of the Jaws.

Epithelioma of the jaws is not a primary disease, but secondary to an already existing epithelioma in adjacent structures, from which by continuity of tissue infection occurs. The disease may commence at the edge of a tooth, or on the gum, or lip, or elsewhere, and spread to the bone directly, or, a lymphatic gland under the jaw becoming infected, the bone may be involved from that source. A sinus kept open for many years by a carious tooth or bone may become epitheliomatous, thus the the jaw be affected.

The diagnosis and treatment depend upon the condition and situation of the soft structures involved in the original growth, and any operation on bone must be undertaken simply as complementary to the operation for the removal of the original disease in the soft tissues.

Operations on the Jaws.—For excisions and operations on the jaws the reader is referred to Vol. I. pp. 806 to 811. To avoid a flow of blood into the windpipe is a thing always to be thought of in opera-

tions upon the jaws, and in extensive operations the performance of a preliminary tracheotomy is expedient. I have done severe operations upon the jaws without a preliminary tracheotomy by putting the patient in the following position—viz. lying on the side, the face turned toward a window giving good light, and the head supported by a firm pillow so as to hold the head level; the lower angle of the mouth can then be depressed by a proper retractor in the hand of an assistant, and during the operation the blood flows out of the mouth and not toward the trachea. By splitting the upper lip into the nostril I have been able in this position to take out an upper jaw. It is the position which I choose by preference in operations upon the mouth not so extensive as to require a tracheotomy. Anæsthesia is of course to be induced, and I always use chloroform in this position, for with it the inhaler can be removed much of the time from the patient's face, thus exposing well the field of operation. With ether, on the other hand, a more continued inhalation is required, and the inhaler is more apt to be in the way of the operator.

SURGICAL DISEASES OF THE SKIN.

By W. A. HARDAWAY, M.D.

Disorders of the Glands.

COMEDO.

This is an affection of the sebaceous glands in which their excretory ducts are plugged up by inspissated sebum and epithelial cells. The acarus folliculorum is occasionally found in the comedo, but its presence is apparently accidental. The common situations of the comedones are the nose, forehead, cheeks, chin, inside of ears, and also the chest and back. The accumulations are generally black, looking like grains of gunpowder, and produce elevations of pinpoint to pinhead size, although rarely they may be slightly depressed. If a comedo be compressed, a little filiform mass of sebum may be extruded, which fact gives rise to the popular term "flesh-worm." Comedones vary in number from a few scattered here and there to many hundreds, and are present in all cases of acne, and usually in seborrhœa. Cases of double comedo have been observed.

Thin [1] and Crocker [2] describe what is called "grouped comedones," which have no connection with acne, and occur in dyspeptics and on those parts of the cheeks where flushing after meals is most decided. They form symmetrical groups of densely-crowded black points, smaller and more uniform in size than the common kind, and show little tendency to suppurate. The last-quoted observer, and others since, have called attention to comedones in children, which appear on the upper part of the forehead in boys, on the temples in girls, and on the cheeks of infants.

Etiology.—Comedones are most frequently seen in young persons with coarse skins, are usually associated, as in acne, with disorders of the gastro-intestinal tract, and are common in persons of strumous habit. It is presumed that comedones in children result from warmth and moisture, and it has been suggested that, as occasionally they appear quasi-epidemically, this apparent contagiousness may be due to some micro-organism.

Diagnosis.—This offers no difficulty.

Treatment.—The internal treatment consists in the administration of tonics when indicated, the regulation of the functions of the stomach and bowels, and the prescription of a suitable diet. Persons of sedentary habit should be encouraged to take a sufficiency of exercise, and the sponge bath, with brisk towelling, insisted upon as a hygienic measure of the highest value.

[1] *Lancet*, Oct. 13, 1888.

[2] *Ibid.*, Oct. 27, 1888.

Locally, stimulating washes, such as the tincture of green soap, may be advised, together with expression of the sebaceous plugs by a watch-key or other suitable extractor. Unna recommends a paste of this sort smeared over at night, as it materially softens the plugs:

℞. Aceti,	ʒij;
Glycerini,	ʒiij;
Kaolini,	ʒiv.—M.

Prognosis.—Usually favorable.

MILIUM.

A milium is a little subepidermic tumor caused by retention of secretion in a sebaceous gland. Milia occur for the most part on the face, especially under the eyes, over the cheeks, and on the forehead. They are of a whitish or yellowish color, and vary in size from a pinpoint to a pinhead, and in numbers from two or three to dozens. When found upon the penis and scrotum they are much larger than elsewhere. They remain unchanged for years, but sometimes the contents undergo a calcareous degeneration, forming the so-called cutaneous calculi. It is not uncommon to find milia on the faces of new-born children (strophulus albidus). They are often seen in connection with acne, also on the sites of pemphigus bullæ, and in the wake of various ulcerative and atrophic conditions.

Milia may be mistaken for xanthoma when of a yellow color and seated upon the eyelids, and perhaps for molluscum epitheliale.

Treatment.—They may be readily shelled out after a superficial incision, but by far the most ready method is, as originally advised by the writer, to puncture each little tumor with a fine needle attached to the negative pole of a galvanic battery.

ATHEROMA.

An atheroma or sebaceous cyst is a cyst lined with epithelium, containing sebaceous-like matter. In size atheromata vary from a pea to an orange. They occur as round, sometimes slightly flattened, swellings that are elastic to the touch. The tumor usually slides freely over the underlying tissues, but the skin over it, though normal in appearance, is often adherent to the growth. Often at the apex of the cyst may be seen a black point, which represents an opening into the cavity of the tumor, through which a thick whitish mass, often with a fetid odor, may be squeezed. An atheroma after injury or spontaneously may suppurate; after discharging its contents an ulcer covered with fungous granulations may be left which may closely resemble an epithelioma. At other times, after the rupture of the cyst, a cutaneous horn forms. In old cysts the contents undergo a calcareous change. Atheromata usually occur on those parts normally supplied with sebaceous glands, as the face, head, neck, and back, but after wounds they have been observed in regions not supplied with sebaceous glands.

There is difference of opinion in regard to the pathology of seba-

ceous cysts, some contending that they are the result of occlusion of the ducts of sebaceous glands, with consequent accumulation of the secretions, while, according to other authorities, atheromata are in reality dermoids. It has been suggested that those cysts which follow wounds of parts where no sebaceous glands are normally found are due to epithelial structures implanted in the wound.

If a patent duct exist through which the contents can be squeezed, no mistake in diagnosis is possible. When the duct is absent the tumor is most likely to be mistaken for a lipoma, but the position, the absence of lobulation and dimpling of the skin over the growth, as well as the fact that the tumor does not slide so readily away from the finger pressed at its edge, will mark the cyst. Cases have been reported where a soft subcutaneous malignant growth has been regarded as an atheroma, and a fungating atheroma with edges thickened by inflammation may resemble an epithelioma; in both cases an appeal to the microscope would determine the diagnosis.

Treatment.—In most cases the best treatment of atheroma is to divide the skin down to the wall of the cyst, and then to dissect out the sac, taking care not to rupture it. Another method is to split open the sac, and, seizing its thick lining membrane with forceps, to drag it from its attachments: by this method there is liability to recurrence, as some fragments of the secreting membrane may be left behind. Lutz of Honolulu speaks in high terms of the use of iodine to cause an obliterating inflammation. The tumor is split open, its contents evacuated, and the interior painted with tincture of iodine. This method is of especial application where the skin is so firmly adherent to the sac as to make it difficult to dissect it out.

INFLAMMATIONS.

DERMATITIS TRAUMATICA.

Under this designation it is customary to group those inflammatory changes in the skin due to traumatism, such, for example, as excoriations and abrasions from scratching, from the irritation set up by ill-fitting shoes, badly-applied bandages, trusses, etc. When the irritation is long continued decided pigmentation and thickening of the skin result.

The **treatment** consists in the removal of the exciting cause and a resort to soothing remedies, such as bland powders and the application of antiseptic ointments containing boracic acid and salicylic acid, more especially Lassar's paste, which is made as follows:

℞. Acidi salicylici,	gr. x;
Pulv. amyli,	
Zinci oxidi,	āā. ʒiij;
Vaselini,	q. s. ad ℥j.—M.

PERNIO.

Persons of a feeble circulation are liable to the condition known as erythema pernio, or chilblain, on exposure to a sufficient degree of cold. Sometimes the amount of cold which produces a chilblain is surprisingly

slight. The affection most commonly occurs upon the hands and feet as ill-defined erythematous patches of a somewhat dusky hue. There is often intense itching and burning. From the severity of the original frost-bite or from subsequent irritation more severe effects may result: blebs may form, followed by ulceration or sloughing; gangrene sometimes follows a frost-bite.

The only other disease with which chilblain is apt to be confused is lupus erythematosus affecting the hands and feet, but the longer duration of lupus erythematosus and the fact that it leaves atrophic scars will differentiate it.

To prevent chilblain the extremities should be clothed in warm woollens. No shoe should be worn which presses around the ankle. An abundance of active exercise should be ordered for young persons, and if there is any defect of general health, it should be as fully corrected as possible. When a chilblain is seen soon after its inception, calamine lotion, to which has been added 2 per cent. of carbolic acid, should be mopped on. At a later period something more stimulating, as painting with tincture of iodine or rubbing in a liniment composed of equal parts of belladonna and camphor liniments, will be required. The part should then be enveloped in cotton and a bandage applied. If the skin be broken, the following ointment spread on cloth may be applied:

℞.	Acidi borici,	gr. xx;
	Bismuthi subnit.,	ʒvj;
	Lanolini,	
	Vaselini,	āā. ʒss.—M.

Ulceration and gangrene must be treated on general surgical principles.

DERMATITIS VENENATA.

A large number of substances, both vegetable and mineral, when brought into contact with the skin are capable of setting up inflammatory conditions of greater or less severity. White[1] in his valuable monograph has shown that more than sixty plants are to be found in the United States that may give rise to dermatitis of varying degrees. In particular, there are three species of plants found in this country that are capable of producing active inflammation of the skin of persons exposed to their influence, whether from actual contact or merely proximity. These are Rhus toxicodendron, or poison ivy; Rhus venenata, or poison sumach; and Rhus diversiloba, or poison oak.

The character and degree of inflammation from rhus-poisoning are by no means uniform. Sometimes it is merely an erythema, or there is slight papulation, or, in the worst form, there occurs acute swelling of the skin with the formation of vesicles, pustules, and blebs. There are marked sensations of itching and burning. The hands, face, and genitals are usually involved, sometimes the entire surface. The disease may last from one to six weeks. The poisonous principle, a volatile acid, may be conveyed in an early stage of the affection from one part of the body to another, or perhaps to a second person; but, according

[1] *Dermatitis Venenata*, Boston, 1888.

to White, after the poison has been absorbed or removed by washing or volatilization, there is no risk of contagion. The effects of exposure show themselves in from a few hours to several (four or five) days.

Susceptibility to rhus-poisoning, once established, would appear to be permanent.

Treatment.—The treatment of dermatitis venenata should be conducted on general principles, taking care, of course, to rid the skin of the source of irritation as soon as possible. There are many so-called specifics for rhus-poisoning, for the reason that the dermatitis varies greatly in degree, and the affection runs a tolerably definite course. Under any circumstances a method of much value is to wash the affected parts immediately with soap and hot water. This is to be done freely and for a considerable time. As a medicinal application I have found hourly mopping with sulphate-of-zinc lotion of the strength of from ʒj–ʒss to water Oj to be of much service. Black wash—calomel ʒj, lime-water Oj—is an excellent application used as a lotion upon linen for half an hour at a time. This should not be used over too extensive surfaces. A remedy of universal application is, according to White, made as follows:

℞. Zinci oxidi, ʒiv;
Acidi carbolici, ʒj;
Liq. calcis, Oj.—M.
Sig. Shake and mop over affected surface repeatedly, day and night.

Many other substances that are in common use, either medicinally, in the arts, or for domestic purposes, cause under certain circumstances irritations and inflammations of the skin. A chief offender in this regard is the much-employed tincture of arnica. The aniline dyes are also responsible for no inconsiderable amount of dermatitis in susceptible persons, although of late years there has been, for some reason, a considerable falling off in such cases, perhaps due to improved processes of manufacture.

This list could be almost indefinitely extended, but space will permit of only a brief additional list of common irritants—viz. tar, mercury, bichromate of potash, chrysarobin, croton oil, cantharides, turpentine, etc.

DERMATITIS GANGRÆNOSA.

Gangrene of the skin may result from a great variety of causes, local and constitutional; for example, it may follow upon the prolonged or excessive action of heat or cold, from the application of chemical agents, from the ingestion of ergot, from shock, and in symptomatic connection with various cerebral and spinal disorders; also from changes within the vessels, alterations in the vessel-wall, and from external pressure.

From the clinical standpoint the following types are worthy of especial attention:

SPONTANEOUS GANGRENE OF THE SKIN.

This form of gangrene occurs mainly in hysterical young women, and consists of irregular plaques, unsymmetrically disposed, and some-

times, it is said, spreading in a serpiginous manner. It is more than likely, however, that this condition is, in the majority of cases, always artificially produced; yet it is possible that the derangement of the nervous system incident to the hysteric may be responsible at times.

DERMATITIS GANGRÆNOSA INFANTUM.

Gangrene of the skin in strumous and syphilitic children is of not infrequent occurrence after varicella and other cutaneous affections. It is most common under the age of three years, and consists of superficial or deep ulcerations covered by a slough and situated at the site of the original lesion, or it may be independently.

The disorder presents considerable variations in intensity. In some cases the patches of gangrene are widely scattered and numerous, accompanied by high fever and leading to a rapidly fatal ending; or there may appear a series of small pustules, each of which sloughs and leaves a minute cicatrix, with an indefinite prolongation of the disease by successive crops.

Etiology.—The opinion originally held by Hutchinson, that all these cases followed either varicella or vaccinia, has now been surrendered; for, although perhaps most frequent after these disorders, it would seem that under certain dyscrasic states—*e. g.* syphilis and tuberculosis—the disease may have its starting-point in any pustular, vesicular, or bullous disease of the skin. Microbic infection is highly probable.

Diagnosis.—This should present no difficulty.

Treatment.—Tonic and supporting treatment is usually urgently demanded. Crocker thinks well of sulphocarbolate of soda in five-grain doses, and quotes Coutts as getting a good result with opium. Carbolic-acid poultices may be used until the sloughs have separated, and subsequently the ulcers may be dressed with iodoform or aristol, either dry or in vaseline.

Prognosis.—In young children with extensive local involvement, high fever, and other complications the outlook is grave.

SYMMETRICAL GANGRENE (RAYNAUD'S DISEASE).

This affection, first described by Maurice Raynaud, consists of three morbid conditions, probably due to one and the same cause—viz. vasomotor spasm of the arterioles, usually of the extremities, and a consequent retardation or arrest of the circulation in the parts attacked. Raynaud divided the disease into three stages as follows: local syncope, local asphyxia, and local gangrene. The process does not necessarily pass from one stage into another; it may stop short of the extreme stage of the disease or exhibit other variations in its course. Neither is it always symmetrical, and other parts of the body may be attacked, such as the nose, ears, etc.

Local Syncope.—In the disorder popularly known as "dead finger" the fingers or toes become bloodless, cold, and dead-white. When sensibility returns there is more or less painful reaction in the shape of burning, tingling, and pain. Women are more apt to be attacked than

men, and the attacks usually supervene after exposure to cold or as the result of mental emotion.

Local Asphyxia.—This stage may be preceded by attacks of local syncope, or the parts may suddenly become cyanosed and cold and present a bluish-white or blue-black appearance. In the majority of instances the extremities, fingers and toes, are the points of attack, and the invasion is symmetrical. More rarely the ears or nose is involved, a portion or the whole of the leg, or the disease may be limited to livid patches on the backs of the hands, limbs, or trunk. Both the subjective symptoms and the duration of the asphyxia present considerable variations. Pain and burning may be intolerably severe or comparatively slight, and the attack may last for a few seconds only or persist for several hours or days. The attacks may come on irregularly, sometimes several times in a day, especially after exposure to cold, or they may be markedly quotidian in type. After repeated paroxysms the affected digits may, in some cases, become flabby and œdematous. English observers have shown that hæmoglobinuria may be a concomitant phenomenon during this stage of the disorder.

Local Gangrene.—In this stage the fingers may become pallid, then turn lilac, violet, or lividly blue. There are usually burning, itching, and severe pain. The neighborhood of the affected parts takes on a livid mottling, and the members become black and insensitive to touch. Vesicles or blebs form, which presently burst and leave small ulcers that heal after a few days. After this process has been frequently repeated the fingers shrivel up and show numerous little white scars and distorted nails. In other instances phlyctenulæ do not appear, but the digits become black and gangrenous, and a superficial or deep slough forms, occasionally attended by loss of the distal phalanges or even more extensive destruction. The general health may be good in spite of the intense pain, although I have seen patients much reduced from this latter cause. As in the milder grades of the affection, other parts may be attacked, but are not so apt to slough, although sloughing does occur.

Etiology.—Raynaud's disease is more common in males than in females; it is most frequent between the ages of fifteen and thirty, although it has been often observed in young children. Lowered temperature and mental emotions are immediate exciting causes. It is associated with many and rather diverse general states, such as syphilis, tuberculosis, malaria, and particularly hæmoglobinuria. Heredity would seem to play some part in its production. Whether the spasm of the arterioles is due to central or peripheral irritation is as yet undecided, some authorities regarding it as central and due to a blood-poison, and others as a peripheral neuritis.

Diagnosis.—The disease may under some circumstances suggest both chilblain and senile gangrene, but attention to the history of the case will readily prevent a mistake in these directions.

Treatment.—The general treatment consists in due attention to the health, and it is said that much can be accomplished in the earlier stages by preventing exposure to cold and securing a good circulation by appropriate bathing and judiciously selected clothing. Quinine internally has appeared of benefit in some cases. I have tried the nitrate of amyl on theoretical grounds, but without any good result. Raynaud recom-

mended the use of a descending galvanic current. If applied to the spine, the positive pole is placed in the region of the neck at the 6th cervical vertebra, and the negative at the sacrum and lower lumbar region; or the negative pole may be applied directly to the affected parts. Barlow directs that the affected limb should be placed in a basin of warm water and salt together with one pole of the battery, while the other pole should be placed on the member at its upper part. A current should be used as strong as the patient can tolerate. Shampooing is also a valuable adjunct. In the gangrenous cases the parts are treated on the ordinary surgical principles for such conditions. At times amputation may be necessary.

DERMATITIS FACTITIA.

Feigned eruptions or various lesions of the skin that have been artificially produced by hysterics and malingerers are far from rare.[1]

In establishing a diagnosis—a matter of much difficulty, both moral and physical, in some cases—it is necessary to keep the following points in mind: In the first place, we should ascertain the antecedents of the patient, and take particular note of the present condition; secondly, we should discover if the patient has ever suffered from any skin disease before, and whether he had been, or was at the time, making use locally or internally of any medicinal preparations. We should make a mental comparison of the lesions present with other known eruptions of the skin, and note any especial anomaly. The local expressions of the manifestation should be closely investigated as regards, for example, infiltration, itching, burning, etc. Finally, it must be remembered that most eruptions produced with intent to deceive generally occupy accessible situations, and in right-handed people, for instance, are apt to be found on the left side of the body.

The late Dr. Tilbury Fox has pointed out that the simulated skin affections are usually of the following forms: The eruption is in erythematous or excoriated patches, such as may be produced by rubbing or by mustard; or bullous or pustular or deeply ulcerative; or such lesions as could be caused by cantharides, croton oil, or some corrosive acid; or such an eruption as could be brought about by the constant forceful use of the finger-nails; or it is a pigmentation—*e. g.* simulating chromidrosis—produced by black lead, candle-black, nitrate of silver, grease, and other compounds.

FURUNCLE.

A furuncle is an acute inflammation about a gland of the skin which generally results in necrosis and suppuration. Boils may occur singly or in crops. The crops may succeed one another for an indefinite time, constituting the condition known as furunculosis. Boils occur most often on the face, neck, buttocks, legs, and arms. A boil commences as a little induration deep in the skin, light red in color, and tender to the touch. As development progresses the elevation becomes more marked, the color gets a bluish tint, and an inflammatory areola forms around the

[1] Hardaway, "Observations on Feigned Eruptions," *St. Louis Courier of Medicine*, May, 1886.

base. Usually at this time a small yellow point may be seen at the apex of the furuncle. If left alone, in two or three days the boil opens and discharges pus. A white plug caused by necrosis of the affected gland, the core, can now be seen in the opening. This comes away in a day or two, involution commences, and by the end of two weeks a purplish scar is left to mark the spot where a boil has occurred. While a boil is forming there is intense pain of a throbbing character.

When a sweat-gland is affected, the course is somewhat different from that just described. The swelling is less. At maturation a pea-sized, round, red, soft swelling is found, which contains a few drops of pus. This form of furuncle is not so painful as the ordinary sort. It is most common in the axilla, in the fork, and about the genito-anal region.

Etiology and Anatomy.—A boil is the result of the inoculation of a hair-follicle or gland of the skin with pus-producing organisms, the most common one being the staphylococcus pyogenes aureus. As in most infectious diseases, so in boils, a certain suitability of the soil seems to be necessary in order that the germs may flourish. Boils are most liable to develop after a lowering of the vitality of a part either from local or general causes. In those who must sit continuously boils are common on the buttocks. Furuncles often occur in successive crops in diabetes mellitus, Bright's disease, and after specific fevers. The pus from a boil is readily inoculable, and this accounts for the frequency of secondary boils in the neighborhood of the primary one. Boils are of common occurrence in the itching diseases, being inoculated during scratching.

Diagnosis.—The diagnosis of furuncle is generally not difficult. From carbuncle it is distinguished by presenting only one point of suppuration, while there is much less induration of the surrounding tissues.

Treatment.—In the treatment of furuncles the first thing is to ascertain carefully the state of the general health of the patient. In those who are run down the administration of tonics and a proper regulation of the diet and hygiene are indicated. The urine should always be examined for sugar, albumin, or casts. If any source of infection can be discovered, it should be removed. In this connection the condition of the sewerage of the patient's house should be ascertained. Many remedies have been advanced as exerting a favorable influence on the course of boils. Most of them are totally inefficacious. Among those which have the best established reputation are fresh yeast, half a wineglass morning and evening, sulphide of calcium, gr. $\frac{1}{4}$ every three hours, the mineral acids, compound syrup of the hypophosphites, arsenic, and liquor potassæ.

The local treatment is of more importance than the internal treatment. It is desirable, if possible, to abort a boil in its early stages. Guigeot has recommended applying several times a day, for a few minutes at a time, compresses wet with spirits of camphor. Another method consists in applying freely on and about the boil tincture of iodine till free desquamation occurs. What often gives ease, even if it does not cut short the inflammation, is a cotton compress wet with a 3 per cent. solution of carbolic acid, placed over the boil, covered by a piece of rubber tissue larger than the compress, and held in place by a bandage. A good method of treatment in the early stage of a boil is to

paint it with pure carbolic acid. None of the ordinary forms of poultices should ever be applied, as they encourage the formation of secondary boils. As soon as suppuration has occurred the boil must be freely incised. Since each boil is a nidus the pus from which may be carried to other parts, precautions to prevent such inoculation should be taken. The cavity, as soon as the boil is opened, should be swabbed out with cotton twisted around a probe dipped in pure carbolic acid, and then filled with iodoform. An antiseptic dressing should then be applied. During the whole treatment it is important to keep the skin immediately surrounding the boil smeared with an antiseptic ointment, for which the following is a good formula:

℞. Acidi borici, ʒj;
Zinci oxidi,
Pulv. amyli, āā. ʒij;
Lanolini, ℥j.—M.

Prognosis.—The prognosis of furuncle is usually favorable. When suppuration has occurred permanent scarring will result. In furunculosis a very guarded prognosis is wise, as often, in spite of our best attention, the disease remains persistent.

CARBUNCLE.

A carbuncle is an acute phlegmonous inflammation which terminates in sloughing of the tissues. Carbuncle occurs most often on the back of the neck, back, shoulders, and buttocks. A carbuncle begins as a firm, flat infiltration in the skin, which increases by extension in depth as well as by extension of the borders. A carbuncle may only be an inch in diameter, while, on the other hand, it may attain such proportions as to cover the whole back of the neck and shoulders. The color is in the beginning a bright red, which changes to a bluish tint. The infiltration of the skin caused by a carbuncle is at first of a peculiar brawny character. By the end of ten days or two weeks the apex of the carbuncle softens and opens at several points. A small amount of sanious pus is evacuated, and through the crater-like openings may be seen grayish sloughs. The sloughs are gradually got rid of through the enlarged openings, the intervening bands of tissue often melting away, and there results a deep irregular ulcer with hard everted borders. This slowly fills by granulation. At times, instead of several openings, the entire skin over the central part of the carbuncle becomes black and gangrenous or breaks down into a grayish slough. Usually only one carbuncle is present upon the body at a time. During the formation of a carbuncle there is much pain of a burning character and constitutional disturbance, which in the aged or debilitated may become of serious import.

Etiology.—Carbuncle most often occurs in those who are already in poor health from other causes. There is an especial association between carbuncle and diabetes mellitus. It has been supposed that trauma often stands in an etiological relation, but this has not been proved. The ordinary pus-cocci play an important part in the etiology of carbuncle, the disease being usually due to their presence.

Anatomy.—According to Warren, the peculiar cribriform arrangement of the openings of a carbuncle is due to the anatomical construction of the skin in those parts which are most often attacked. The inflammation occurs in the subcutaneous tissue under the thick fibrous layer which exists, especially on the back. The products of inflammation pass up along certain columns of fat into the papillæ, whence they rupture through the undermined epidermis.

Diagnosis.—If the points mentioned in the description of carbuncle are borne in mind, it is not likely to be confused with any other disease.

Treatment.—All the defects of health must, as far as possible, be corrected. As there is often much depression of the vital forces, it may be necessary to institute a supporting treatment from the beginning. When stimulation is deemed advisable, some form of alcohol will be found most reliable. It will sometimes be necessary to give morphia on account of the severity of the pain. The use of sulphide of calcium is highly recommended by some on account of its supposed power to limit suppuration.

Locally, quite a variety of methods have been advised, from heroic surgical procedures, such as crucial incision followed by scraping with the sharp spoon, to the use of medicinal applications. Hypodermic injections of a 10 per cent. solution of carbolic acid into the affected tissue, if made early, will sometimes abort the disease. Cotton compresses, soaked in a 5 per cent. solution of carbolic acid and covered by rubber tissue, generally afford relief and often seem to limit the inflammation. Another good dressing is an ointment of a drachm of iodoform to the ounce of unguentum vaselini plumbicum, spread on cloths and applied to the carbuncle. Crocker recommends that at first glycerin of belladonna spread on lint be used, and later unguentum resinæ be applied till suppuration has set in; as soon as the openings have formed they should be syringed out with a carbolic solution, and then filled with iodoform and a moist dressing applied. When the sloughs are slow about separating, and especially if there seems to be much septic absorption, an incision should be made and the sloughing tissue removed with scissors and the sharp spoon. The wound should then be dressed antiseptically. If there is much pain in a carbuncle from tension, there is nothing which will relieve the pain so promptly as an incision.

Prognosis.—When a carbuncle of ordinary dimensions occurs in a person of robust health, the prognosis is good. With increase in size of the carbuncle the prognosis becomes more grave. In the aged and the debilitated carbuncle is always a dangerous malady. When the affection occurs about the head the prognosis seems to be worse than for carbuncle of other regions.

ECZEMA.

Eczema is an acute or chronic non-contagious inflammatory disease of the skin, characterized by multiformity of lesion, and presenting in varying degrees of intensity the symptoms of itching, infiltration, and discharge. Redness of the skin, the result of active or passive congestion, is always characteristic of the disease. It may be regarded as the initial stage of eczema, and sometimes subsides without further changes.

This redness does not occupy sharply-defined areas, but shades off insensibly into the surrounding unaffected skin.

According to the degree and extent of the inflammation, the exudation may be sufficiently great to remove the upper layer of the cuticle and gain access to the free surface in the form of a discharge without the previous existence of vesicles or papules. Pye-Smith insists, however, that this weeping stage is due to the rupture of minute vesicles, and that even the papular forms of eczema should be regarded as abortive vesicles. Under other circumstances, especially if the congestion is most intense around the follicles, pointed red papules make their appearance; or, if a less plastic and more abundant exudation occurs, the epidermis is raised and vesicles are formed; or, again, as the result of a more persistent irritation or in subjects of a strumous habit, pustules will make their appearance (Bulkley). These lesions may rapidly disappear and leave a dry, scaling surface in their wake, or the wall of the vesicles and pustules may rupture and give rise to a serous or purulent discharge which dries in crusts and scales. Desquamation is the final stage of an eczema, and it may supervene not only on the forms last described, but follow a purely erythematous inflammation. Another objective symptom of great importance is thickening or infiltration. This symptom is always present, and although in recent and superficial forms of the disease it may be only appreciable by comparing the involved region with the healthy skin, when the eczema has extended and become chronic the infiltration may include the whole thickness of the derma and the fatty layer. So long as any of this thickening continues the eczema is not cured, the itching will continue, and the disease will be apt to return with renewed intensity. In certain situations, such as about the joints and on the palms and soles, owing to the thickening of the skin and its consequent inelasticity, painful cracks and fissures are prone to occur.

The chief subjective symptom of eczema is itching, and this will vary considerably according to the location and character of the disease, the age of the patient, and other factors. As a rule, the general health of the patient is unimpaired.

Acute and Chronic Eczema.—Clinically, eczema may be divided into acute, subacute, and chronic varieties. An attack of eczema may be ushered in with some slight degree of constitutional disturbance, but often no such disturbance is apparent; the local symptoms, however, exhibit the usual signs of inflammation—viz. burning, tingling, or itching, together with redness, heat, and swelling, to be followed by some one or several of the forms of the disease presently to be described. On the other hand, the disease may, and generally does, begin more insidiously, and is subacute from its inception. In this latter condition the pruritus and infiltration is moderate in degree, but at any time, from a variety of influences, the more acute process may supervene, or, the disease continuing, the thickening and itchiness become more marked, other secondary changes occur, and the eczema lapses into a chronic stage which may last for years.

Eczema is characterized by a polymorphous eruption consisting of erythema, papules, vesicles, etc., and, moreover, any one of these lesions may be present singly or more or less together, or else one lesion may

be converted into another; still, at times one or another of these elementary forms may so predominate as to establish the anatomical general type of eruption. In this way it is customary to speak of *e. erythematosum*, *e. papulosum*, *e. vesiculosum*, and *e. pustulosum*.

The secondary changes that occur in eczema are, however, of more importance generally and are met with more frequently in practice. They are as follows: Eczema rubrum, or madidans, may supervene on any of the varieties just enumerated, and consists of a raw, red, and weeping surface due to shedding of the upper layers of the epithelium, with consequent exposure of the rete. In its most typical form it may be observed on the faces of children and on the legs of elderly people. The itching is very severe. Squamous or scaly eczema may follow any of the elementary forms of the disease, and is usually indicative of a decline in the activity of the inflammatory process. It occurs mostly in patches of variable size that are red, infiltrated, and covered with large or small scales.

Other secondary conditions encountered in the course of chronic eczema have received appellations that more or less accurately describe the objective conditions present. Thus, when the infiltration is excessive and the skin is of a board-like hardness, it is called eczema sclerosum; when there is notable hypertrophy of the papillæ and the skin presents a diffuse warty condition, it is characterized as eczema verrucosum; if the deeply infiltrated skin is cracked and fissured, the state is termed eczema fissum. Whether eczema may be called a medical or surgical disease is a matter of no great practical moment, but those conditions arising out of the disorder, and aptly called by White[1] its surgical sequelæ, concern the surgeon very closely.

Ulceration of the lower limbs, so frequent in the laboring classes, is an exceedingly common and a most troublesome complication. It is mostly encountered in elderly people who are obliged to stand much and as a consequence suffer from varicose veins. As a result of the impeded circulation the inflamed tissues readily break down. Klotz[2] calls this condition "dermatitis hæmostatica," and regards it as distinct from eczema. In the writer's opinion it is quite possible that there may be no antecedent eczema, but certainly such uncomplicated cases are rare. There may be one or more ulcers, and either one or both legs may be involved. The usual situation is the lower part of the leg anteriorly, and they may also attack the foot. These ulcers may be shallow or deep, large or small, one or many, possess an irregular shape with somewhat undermined edges, and are usually surrounded by a zone of red, oozing, and infiltrated skin. The feet and legs are œdematous, and often quite brawny to the touch, and the presence of varicose veins and obstructed lymphatics may be often detected. The ulcers may secrete a puriform discharge, or the secretion may be scant and the base of the ulcer have a glazed appearance, or it may be covered with exuberant flabby granulations. There is usually considerable itching in the circumjacent parts, and the patients complain much of soreness in the ulcer and of a deep boring pain in the leg itself.

ECZEMA OF THE ANUS and the neighboring parts frequently also

[1] *Internat. Ency. Surgery*, N. Y., 1882.
[2] *Journ. Cutan. Diseases*, Oct., 1891.

gives rise to surgical complications and sequelæ. Eczema in this region often has an insidious beginning, and but rarely shows itself in the acute form. The anus alone may be the seat of the disease, or the perineum and genital organs may be simultaneously involved. Often the muco-cutaneous folds are congested, slightly thickened, and with or without fissures. In most instances there is a free and very offensive discharge. In other cases the parts are red, greatly thickened, and the seat of painful cracks, and the eczema extends up the mucous membrane of the anus. One of the painful manifestations of the disease is the implication of the raphe in the process. Intolerable pruritus, which is worse at night, is the chief thing complained of, although pain, the result of the fissures and also due to the rawness left from scratching, is a prominent factor in the misery from which these patients suffer. Many of these cases are complicated with hemorrhoids, which are often undoubtedly the principal etiological factors in the production of the eczema.

Furuncles and even deep-seated abscesses often follow in the wake of eczema, and in the cases of children especially produce much distress, and are not altogether devoid of dangerous consequences. This post-eczematous furunculosis is due to pus-infection the result of scratching.

Finally, in considering the surgical sequelæ of eczema it must be remembered that in favorable situations, such as the scrotum, the penis, and the lower limbs, a long-continued eczema is capable of producing profound thickening and induration of the tissues quite elephantiasic in character. In a chronic eczema of the penis under the writer's care an enormous thickening of the prepuce had resulted, which it was found necessary to amputate.[1]

Etiology.—Eczema is the most common of the diseases of the skin, representing somewhat more than 30 per cent. of all cutaneous disorders. It is essentially a catarrh of the skin, and may be evoked by the greatest variety of exciting causes, whether these be external or internal. For example, gout, rheumatism, uterine or stomachic disorder, may be the respective influencing agency in a given case, while a purely local irritation may be the *fons et origo mali* at another time. In this latter sense eczema may be due to parasitic invasion. While, however, eczema is a dermatitis, a dermatitis is by no means an eczema, for the latter presents features that are entirely wanting in the first-named condition.

Of principal interest to the surgeon are those forms of the disease that are brought about by causes connected with his professional work. For example, more or less eczema is produced in susceptible subjects by the irritating effects of certain liniments and ointments and the various dressings employed in the antiseptic toilet. Many surgeons with eczematous skins are great sufferers, especially on the hands, from the effects of exposure to the irritating influence of mercury and carbolic acid. It will also readily be seen how mechanical appliances, such as trusses and braces, splints, poultices, water dressings, the rubber bandages, etc., etc., may result in eczematous inflammation.

Treatment.—The treatment of so protean a malady as eczema cannot be entered upon here, especially as it has been the object of this section to call attention more especially to those phases of the disease with which the surgeon is particularly concerned. It is important that the

[1] Hardaway's *Manual of Skin Diseases*, Lea Bros. & Co., p. 124.

general rules of hygiene should be enforced and that a judicious dietary should be prescribed. There are no specifics for the disorder, and consequently each case must be treated on its merits; that is to say, exciting and complicating agencies must be removed or ameliorated wherever possible. In quite a large number of cases internal remedies are uncalled for, either because the disease has been evoked by purely local causes or because the internal exciting cause has ceased to be operative, and there remains only the effects, which must be removed by local means.

In acute vesicular, erythematous, and papular eczemas lotions and powders of a soothing and astringent character are almost invariably indicated, whereas in subacute forms of the disease, especially where there is much exudation and crusting, ointments of various kinds, such as lead, mercury, and zinc, are more efficacious. In scaly eczemas the tars in salve form or in solution find their chief utility. In chronic cases, when the skin is much infiltrated, the object of the treatment is to cause resorption of effused material by such means as potash soap or solutions of caustic potash, or actually to remove the greatly thickened skin by salicylic acid or even mechanical means.

The form of eczema usually encountered by the surgeon, resulting from the application of irritating liniments, ointments, and such like, is mostly acute in character and is best treated by lotions. A remedy of almost universal application is the following:

℞. Zinci oxidi, ℥ss;
Pulv. calaminæ præp., ℈iv;
Glycerini, ℥j;
Liq. calcis, ℥vij.—M.
Sig. Shake. Mop on with rag several times daily.

Under some circumstances it is better to dip cheese-cloth, cut into suitable strips, into this lotion and bind them on neatly with a roller. Other preparations of value are the black wash, pure or diluted, and solutions of lead and opium of varying strengths. Powders are also of considerable efficacy at times, as, for example, oxide of zinc ʒij to lycopodium ℥j, or the powdered oleate of zinc with a grain of thymol to the ounce.

Local eczema from the pressure of braces, trusses, splints, etc. may be easily prevented if the underlying surfaces are protected with any simple dusting powder, preferably borated talcum or a preparation containing a small quantity—about 1 per cent.—of well-triturated salicylic acid. If the parts have already become inflamed, the removal of the exciting cause is usually sufficient to cure the disease. If the skin has become somewhat infiltrated, Lassar's paste will speedily restore it to a normal condition:

℞. Acidi salicylici, gr. x;
Pulv. amyli,
Zinci oxidi, *āā.* ʒiij;
Vaselini, q. s. ad ℥j.—M.

When properly made—that is to say, thoroughly rubbed up—this pa is unequalled as an application to all forms of intertrigo, but if ill-p pared and gritty it acts as a direct irritant.

In local patches of eczema attended by more or less crusting an degree of infiltration, an all-around remedy of great value is the ungu tum vaselini plumbicum, which is made by melting together equal p of vaseline and old lead plaster. This should be spread on strip muslin and then bound on with a roller bandage. When there is m itching it is well to add 1 per cent. of carbolic acid to each ounce of salve.

For the treatment of eczematous ulcers of the legs there are in merable remedies, and the explanation of this state of affairs is not to seek. In a disease which is often intractable it is but natural th legion of methods of treatment should spring up, and as each on successful in some cases, it is not strange that it has its champi Since eczematous ulcers nearly always occur in those affected with v cose veins, it is of prime importance to attend to this condition. haps the most effectual manner of relieving the chronic conges caused by the dilated veins is rest in bed with the limb slightly elev above the body. Since the necessity of earning a livelihood often vents the patient from receiving the benefit of this plan of treatm we have to attempt to accomplish the same thing in another wa namely, with the elastic bandage. The bandage may consist of he white flannel, or Martin's rubber bandage may be used. The wr believes that in hot weather, when perspiration is free and where th is an abundant discharge from the ulcer, the flannel bandage is pre able, as it does not hold the secretions in contact with the skin as the rubber bandage. In applying the rubber bandage certain pre tions are to be observed. The leg must first be dusted with a pow such as is recommended above for use under trusses. A loose w cotton stocking is then drawn on, and over this the bandage is appl In using either bandage two things must be attended to: first, to regulate the tension of the bandage that, while it is applied firmly fi the toes to the knee, the pressure gradually diminishes from be upward; second, always to apply the bandage before the patient ar in the morning, and to remove it only after he has retired for the ni Where the constant-pressure effect is wanted it may be necessary reapply the bandage at night in bed.

The treatment of the ulcer itself will depend on the condition sented. In small, shallow, irritable ulcers a soothing treatment generally be demanded. For this purpose unguentum vaselini plum cum spread on cloth and neatly applied under an elastic bandage excellent. In other cases, where the ulcer is deeper, more chronic, indolent, stimulation is necessary. The ulcer should first be carefu washed with a solution of carbolic acid, and then the floor and si lightly dusted with iodoform or aristol; the ulcer as well as the rounding eczematous skin should then be dressed with the unguent vaselini plumbicum. The method recommended by Unna may be us The whole foot and leg is washed with soap and water and the n cleansed with a 1:1000 solution of bichloride of mercury; a jell prepared by mixing 10 parts of oxide of zinc, 10 parts of gelatin,

parts of glycerin, and 40 parts of distilled water; after the ulcer has been dusted with dermatol or whatever remedy is desired, the whole skin of the leg is covered with the jelly, previously melted by heat; a bandage is then applied, each turn being covered with more of the jelly. This dressing may be left on in most cases for a week.

In case there is a free purulent discharge from the ulcer it is important to try to secure a more healthy action by careful antiseptic dressing. The leg should first be carefully cleansed with soap and water, and then both the leg and ulcer washed with a 1 : 1000 solution of *bichloride* of mercury; a dressing of bichloride or iodoform gauze is then applied and a crinoline bandage put on. The frequency with which the dressings are made will be regulated by the amount and character of the discharge. Various new pharmaceutical preparations are being constantly advocated in the treatment of ulcer on account of their antiseptic properties, but the writer is not able to see in them advantages which render it necessary to discard the older remedies.

In old ulcers the border has often become so thickened and so adherent to the deeper tissues as to prevent cicatrization. Sometimes pressure, properly applied, is most efficacious in relieving this condition. The pressure may be got from a rubber bandage or the ulcer may be carefully strapped with surgeon's rubber plaster. It has been advised, after having made the ulcer thoroughly antiseptic, to place over it a piece of rubber tissue large enough to reach some distance beyond the borders of the sore; on this a piece of thin tin, cut to extend beyond the hard margin of the ulcer, is placed, and straps are then neatly applied. This method has seemed to the writer to act beneficially in a few cases in which it has been used.

It may be necessary, when granulation is tardy and the margin of the sore remains obstinately indurated, to make incisions through the border at several points or to circumscribe the edge with incisions extending through the entire depth of the indurated tissue. If, in spite of all, cicatrization is still not to be accomplished, skin-grafting should be tried. The method of Thiersch has superseded other operations for this purpose. The manner of grafting by this method will be found fully described in another part of this work. The writer will merely say that a proper preparation of the ulcer previous to grafting is of the highest importance. The patient should be kept in bed and the ulcer constantly dressed antiseptically till a healthy bed of granulation tissue on which to place the grafts is secured. If at the time of the operation the borders are very much thickened, they should be scraped or cut down till they are more on a level with the floor of the ulcer. By Thiersch's method a perfect result may often be secured in large ulcers where formerly the question of amputation would have come into consideration.

ACNE.

Acne is an inflammatory disease of the sebaceous glands occurring principally about the face and back, and characterized, according to the variety of the process, by papular, pustular, or tubercular lesions.

Acne simplex is usually made up of papules, papulo-pustules, and pustules. In some cases small red pimples predominate (acne papulosa),

which are somewhat conical in shape, and present at their apices minute yellowish or blackish points corresponding to the ducts of the sebaceous glands. The more frequent variety of acne simplex, however, is the papulo-pustular, with the pustules in excess (acne pustulosa). The pustules are freely dispersed over the invaded surface, have a somewhat globular shape, and are seated upon an inflamed base. They vary in size from a pinhead to a split pea. Suppuration may be abundant or slight; in acne simplex the evolution of the pustule is rapid; it may either rupture and discharge its contents or undergo absorption and desiccation.

Acne indurata differs in no way pathologically from the common variety, except in the extent of the inflammatory process. In acne indurata the inflammation is deeper seated and the subcutaneous connective tissue is apt to be involved, and there may be considerable swelling of the parts, and even quite large subcutaneous abscesses may form. The tubercles are usually slow in development, and are indolent in their course; in fact, a hard, inflamed nodule may exist many days before suppuration can be detected. Indelible cicatrices often result.

The so-called acne artificialis, due to the ingestion or topical application of certain substances—*e. g.* iodine, bromine, tar, etc.—calls for no special description. The eruptions thus caused may be slight or exceedingly severe.

Treatment.—Careful dietetic and hygienic rules should be enforced in all cases, and the physician's attention should also be directed to the removal of all complicating disorders, notably affections of the gastro-intestinal tract. According to the necessities of the case, iron may be prescribed for the anæmic, cod-liver oil for the strumous, and saline laxatives for the plethoric. The writer has but little confidence in the so-called specifics—viz. arsenic and sulphide of calcium or any combinations thereof. Sherwell claims that the occasional passage of the cold sound will help certain cases in young men.

The essential surgical treatment of acne consists in the use of local stimulants and of antiseptic lotions, and the free employment of the dermal curette and acne lancet. Occasionally soothing treatment is demanded for a time, but in a majority of cases stimulating preparations may be ordered at once. Sulphur in some form gives the best results:

℞. Sulphuris præcipitati, ʒiij;
Spt. camphoræ, ʒiij;
Sodii biboratis, ʒij;
Glycerini, ʒvj;
Aquæ rosæ, ad ℥iv.—M.
Sig. Mop on face at night.

In some types of the disease with large indurated nodules Vleminckx's solution gives excellent results:

℞. Calcis, ℥ss;
Sulphuris sublimati, ℥j;
Aquæ, ℥x.
Boil down to six ounces and filter.

In the beginning this should be diluted to the proportion of one teaspoonful to five of water; then, after several days, one to four, etc., until in the course of some weeks it shall be used pure. It should be mopped out at night with a flannel rag and washed off in the morning.

There are a great variety of other drugs that may be employed, and perhaps with as good effect; but under all circumstances it is advisable to apply several times during the day a lotion of boric acid:

℞. Acidi borici, ℥ss;
Alcoholis, ℥viij.—M.
Sig. Mop on with a rag several times daily.

All comedones should be expressed with a watch-key or, better, a Piffard's comedo-extractor.

Fox advises that the surface should be gone over thoroughly with a dermal curette, tearing off the tops of papules and pustules, and thus allowing the extrusion of the sebaceous plugs and thoroughly stimulating the skin. Where patients will not submit to this somewhat summary method, the acne lesions may be stabbed with a lancet and allowed to bleed, and the hemorrhage should be encouraged by the application of hot water. In acne indurata the deep-seated nodules should be incised with a free hand, and after the contents have been thoroughly removed the cavities should be lightly touched with pure carbolic acid.

ACNE ROSACEA.

Acne rosacea is a chronic hyperæmia of the skin, often resulting in inflammation of the sebaceous glands and a new growth of connective tissue. The affection attacks nearly always the face, the cheeks, nose, chin, and forehead being the parts most commonly involved. The first evidence of the disease is flushing, in the beginning lasting only for a short time, but eventually becoming permanent. Telangiectases usually develop upon the cheeks and nose. The color of the affected area is some shade of red, gradually fading away into the healthy skin; after the disease has lasted for some time, especially upon the nose, a bluish or purplish tint is added. The impaired circulation interferes with the function of the sebaceous glands, and seborrhœa is the result, usually most marked on the nose, where greasy sebaceous plugs may be seen distending the ducts of the glands. The process may go no farther than this, but generally the sebaceous glands become inflamed and pustules and nodules make their appearance. If the pathological changes are more intense, hypertrophy occurs, the part assuming a hobnail aspect. The nose is the organ most affected by this change, large tumors sometimes forming, producing marked deformity (rhinophyma). The course of the affection is a slowly progressive one, the pathological changes gradually becoming more profound.

Etiology.—Acne rosacea is more common in women than in men. In men it is most often seen after forty years of age; in women it may develop any time from puberty to the menopause. The most frequent cause of acne rosacea is some derangement of the intestinal canal. Uterine derangements also play an important rôle in the etiology.

Diagnosis.—The diagnosis is not difficult. Acne rosacea can be distinguished from simple acne by the more diffusive redness and dilated blood-vessels. From lupus erythematosus it can be differentiated by the fact that in the former disease the skin is covered with adherent yellowish scales, prolongations from which often dip down into the distended sebaceous follicles, while well-marked scarring is often present. Lupus vulgaris will usually show the apple-jelly nodules in the border. Tubercular syphilides may resemble acne rosacea, but will be found to produce ulceration with crusts and scars.

Treatment.—A careful search should be made to ascertain the cause of the disease. The diet and general hygiene are to be regulated in accordance with the principles laid down in connection with acne vulgaris. In the hyperæmic stage lotions of sulphur, mercury, ichthyol, etc. are indicated. (See Acne.) When pustules and tubercles are present, they should be freely incised and the affected region fomented with hot water several times a day. Probably the best local treatment for this stage of the disease is Vleminckx's solution, used as described in Acne.

The best manner of destroying the dilated vessels is by the electrolytic needle, as originally recommended by the writer.[1] The full description of the method will be found under Nævus Vascularis.

Small nodules may be reduced in size or brought to a level with the surrounding skin by repeated transfixion with the electrolytic needle. Large tumors about the nose must be removed with the knife. The nose should be pared down to its natural size. Cicatrization takes place readily and the results are quite satisfactory.

Hypertrophies.

KERATOSIS SENILIS.

Keratosis senilis—or, as it is improperly called, verruca senilis—consists of a collection of epidermic scales, elevated slightly above the level of the skin, of a yellow-brown or black color. As the name implies, the affection is found in advanced life. It most commonly occurs on the face and backs of the hands, but may also be found on the trunk, forearms, and feet. The masses of scales are detached with some difficulty; when removed a red raw surface is exposed upon which the tops of enlarged papillæ may be discovered. The chief importance of keratosis senilis is that it not uncommonly becomes the starting-point for an epithelioma.

In the treatment of keratosis senilis the first requisite is to remove the scales by inunctions with olive oil or vaseline. The following paste should then be kept constantly applied:

℞. Acidi salicylici,	gr. xxx;
Sulph. præcip.,	℥ss;
Pulv. amyli,	℥ss;
Ung. aquæ rosæ,	℥j.—M.

[1] *Archives of Dermatology*, Oct., 1879.

In obstinate cases the salicylic-acid plaster mull of Unna is often of service. When the base upon which the scales are situated is found infiltrated, or there is any other reason to suspect a malignant tendency, radical means, such as excision or destruction with the electrolytic needle, should not be delayed.

ANGIOKERATOMA.

Angiokeratoma is an affection of the extremities characterized by warty growths seated on a vascular base. Most of the cases have developed in young persons who had had chilblains. The first evidences of the disease are small vascular points which appear from time to time, usually in the winter. In the course of time the dilated vessels form elevated plaques one-eighth to one-third of an inch in diameter. The top of the prominence has a warty look, while the base is a bluish-red color. These growths may develop without any previous history of chilblain, as in a case of the writer's. The lesions are generally multiple and seated on the backs of the fingers and toes. They bleed easily and show no tendency to involution.

Anatomically, the growths are found to be due to great thickening of the epidermic layers and the rete, in which latter layer are irregular spaces filled with blood. The papillary layer is infiltrated with small round cells and the vessels are dilated.

In the **treatment** of angiokeratoma the writer has found the use of the electrolytic needle all that could be desired. The base must be thoroughly destroyed or the growth will recur. The operation may have to be repeated several times. Avoidance of exposure to cold should be enjoined and the general health kept up to the best tone.

MOLLUSCUM EPITHELIALE.

Molluscum epitheliale is a comparatively rare disease. The lesions are at first pinhead-sized, grow slowly, and eventually attain the bigness of a pea. They are, when fully developed, sessile tumors of a yellowish or purplish color, the stretched and glistening skin having a semi-transparent, wax-like look. The little tumors are at first firm, but often grow softer as they increase in size. The lesions are often umbilicated, and a small opening may exist through which a gruel-like or even a waxy substance can be squeezed. After attaining maturity the lesions may remain stationary, or suppurate and thus cure themselves.

The most common sites for the eruption of molluscum epitheliale are the eyelids, cheeks, and chin, but the disease may occupy other parts of the body, especially the breast and genitals. The number of lesions in any of these situations is usually small. In rare instances single very large tumors have been noted.

Etiology.—Molluscum epitheliale is much more common in children than in adults. Opinion is divided as to whether the disease is contagious, but clinical evidence seems to point in this direction. Many contend that the affection is of parasitic origin.

Anatomy.—The little tumors consist of a lobulated mass of epithelium which probably springs from the Malpighian layer. The central portion of the mass is made up of round bodies (molluscum bodies),

which are by some considered to be parasites and by others degenerated epithelium.

Diagnosis.—The characteristic appearance of the lesions will make the diagnosis easy.

Prognosis.—If thoroughly destroyed, the growths do not return. If left alone, they increase in number and persist indefinitely.

Treatment.—Each tumor should be split open with a thin knife, the contents removed, and the base touched with nitrate of silver. Electrolysis can be successfully used for the destruction of the lesions.

CALLOSITAS.

Callosities are thickenings of the epidermis which may be congenital, but are usually acquired as the result of local irritation. The most frequent sites for callosities are the palms and soles. They are generally the result of pressure sustained in the occupation of the affected person. The skin is usually thickened over some bony prominence, as the metacarpo-phalangeal joints. The lesions of callositas are of various sizes, rounded in outline, slightly raised above the general level, yellowish or brownish in color, and hard to the touch. The entire alteration occurs in the horny layer of the epidermis.

In the cases where a moderate amount of callous epidermis has been produced by the occupation of the patient it is unnecessary to remove it, as it acts as a protection to the tender layers beneath. In any case to cure the condition it will be necessary to first remove the cause, which may entail cessation from the ordinary occupation. As much as possible of the horny layer, after soaking in hot water, should be pared off with a knife. Salicylic acid in the form of Unna's plaster mull will loosen the remaining epidermis and render its entire removal possible.

CLAVUS.

A clavus or corn is a circumscribed thickening of the epidermis which grows in depth as well as superficially. Corns are most often found where pressure occurs on the toes. Corns are hard or soft according to whether they are in a situation where they are dry or moist. Hard corns occur mostly on the outer side of the little toe and upon the tops of the toes, while soft corns are most common between the toes.

Anatomically, a corn consists of a conical thickening of the epidermis, from the under surface of which a peg of epithelium extends downward and causes by its pressure atrophy of the underlying papillæ. A corn may become acutely inflamed and suppurate, leaving a painful ulcer.

In the **treatment** of corns the first thing is to remove all injurious pressure from ill-fitting shoes. The thickened epidermis should then be removed, after soaking in hot water, with a sharp knife. Another way to effect the removal of the corn is to apply salicylic acid, either in the form of a plaster or in collodion, a drachm to the ounce. The corn should then be neatly strapped with rubber plaster or a felt ring may be worn over it. The soft corn should be removed as above recommended, and the base touched with some mild caustic; after this the feet should be washed every day with soap and water, and bits of absorbent cotton pushed in between the toes to keep them apart.

PERFORATING ULCER.

The disease which goes by the name of "perforating ulcer" is almost invariably connected with some affection of the nervous system, and therefore belongs to the class of affections due to trophic disturbances. In most instances the original malady has been locomotor ataxia or a peripheral neuritis, such as arises in alcoholism, syphilis, or leprosy. The ulcer usually occurs on the plantar surface over the metatarso-phalangeal joint of the big or little toe. Perforating ulcer is probably always due to trauma, though the injury may be so slight as to escape notice. Usually only one ulcer exists, but cases have been seen in which several were present. Not infrequently the ulcer begins as suppuration under a corn which burrows into the soft tissues. Finally, the corn is detached and the orifice of a sinus is exposed, which often leads down to dead bone. From continual pressure in walking the edges of the sinus become much thickened. Often unhealthy granulations present around the edges of the sinus. There is generally no pain connected with perforating ulcer, not even on pressure. There are usually present in part other evidences of neurotic disturbance, such as anæsthesia, loss or deformity of the nails, tylosis, etc.

The **course** of the disease is slow, but progressive.

In the **treatment** of perforating ulcer the essential thing is prolonged rest. Amputation is only to be undertaken as a last resort, since the ulcer is very apt to recur in the stump. Treves recommends paring down the thick edges and filling the sinus with a cream composed of salicylic acid and glycerin, to which 2 per cent. of carbolic acid has been added. After healing, a thick felt pad, cut out over the scar, is to be worn, and every precaution taken to prevent fresh injury.

Stretching of the sciatic nerve has been strongly advocated.

CORNU CUTANEUM.

Cutaneous horns are among the rarities of disease, and have attracted more attention than they are really entitled to from the fact that those having them are regarded as freaks. Horns may occur upon any part of the body, but are most common on the scalp, face, and genitals. There may be only one, or a number may exist. They may be of any size up to a foot or more in length. They are usually twisted, are largest at the base, and taper to a point. The color varies from gray to black. Cutaneous horns are only painful when injured, as by tearing them off or so bruising them that suppuration of the skin at the base results. When torn off a red, raw surface is exposed, from which the horn is apt to be reproduced. The skin at the base of a horn may undergo a malignant degeneration.

The **causes** which bring about the growth of a horn are unknown. Horns rarely occur till after the fortieth year of life. They often start from warts, scars and sebaceous cysts.

Anatomically, a cutaneous horn is made up of laminated epithelium. In the base the papillæ are exaggerated and the vascular supply is increased.

The horn should be torn or cut off, and the base thoroughly cauterized with the actual or galvano-cautery or with chloride-of-zinc paste.

VERRUCA.

A verruca, or wart, is a small papillary growth of the skin. Warts differ much in their appearances. The most common form is the verruca vulgaris, which occurs so often upon the hands and faces of young persons as pea-sized, sessile, horny growths, the tops of which often show a number of minute elevations. At first warts are the color of the normal skin, but later become yellow, brown, or black. This form of wart may occur as a single growth, though more commonly there are numbers present.

When one or two of the papillæ which make up the wart become more hypertrophied than the rest, so as to form finger-like projections, we have the form of wart known as verruca digitata, which is found chiefly on the scalp. Verruca filiformis is a smaller variety of the last form which occurs upon the eyelids and neck as little flabby pouches of skin. Verruca acuminata, or venereal wart, is generally found about the anus or genitals, under the breasts, or on the toes. These warts occur as masses of red, vascular, hypertrophied papillæ, the surfaces being usually covered with a white or yellow secretion which is often very offensive. Acuminate warts may grow rapidly or slowly, but as a rule show little tendency to spontaneous disappearance.

Etiology.—It is a popular belief that warts are inoculable, and scientific experiment seems to bear this out. Many observers have found various organisms in warts, but one that is pathogenetic has not yet been agreed upon. The growth of verruca acuminata is favored by the irritation of discharges, as gonorrhœa, etc.

Anatomy.—A wart is essentially an enlargement of the papillæ of the skin, the vascular fibrous core being covered by horny epithelium.

Treatment.—Various internal remedies have been advocated as curative of warts, among them sulphate of magnesia in sufficient doses to move the bowels two or three times a day, and tincture of arbor vitæ in thirty-minim doses. Local treatment will be found most useful. One of the best methods of treatment is the use of the electrolytic needle. The warts need not be actually destroyed, as after being transfixed they often undergo involution. Salicylic acid in collodion, a drachm to the ounce, painted on repeatedly, will often prove a very useful remedy. Many caustics, such as glacial acetic acid, acid nitrate of mercury, and caustic potash, have been successfully used, but they are more dangerous than the means mentioned and should be used with caution. Venereal warts are treated by washing with an antiseptic lotion and keeping the parts dry and free from the action of irritating secretions. This in itself will often suffice for a cure. If something more is necessary, the application of glacial acetic acid is to be recommended. In the most obstinate cases it may be necessary to destroy the warts by means of the galvanocautery.

NÆVUS PIGMENTOSUS.

A pigmented nævus, or mole, is a deposit of pigment in the skin. A mole may consist of a circumscribed hyperpigmentation only, or alterations in other elements of the skin may be present. These anatomical differences have given rise to various names, such as nævus

spilus, where hyperpigmentation alone is present; nævus verrucosus, when the surface is rough and warty; nævus pilosus, when there are hairs growing from the mole; when a mole is loose, flabby, and contains fatty tissue it is spoken of as nævus lipomatodes.

Pigmented nævi are most common on the face, neck, and back. They are usually under half an inch in diameter, but cases have been reported in which large areas, as the region covered by bathing trousers, have been involved. A number of nævi are sometimes arranged along the course of a nerve; this is found only upon one side of the body, and has therefore been called nævus unius lateralis.

Moles are nearly always congenital, though no doubt some appear in later life. They generally grow as the body grows, but cases are on record in which the border has extended beyond this proportion.

One of the most important facts connected with moles is that in late life, if irritated, they not uncommonly form the starting-point for malignant growths.

Electrolysis is the best method of removing moles when small. The writer has recently succeeded in removing by this method a verrucous mole two inches in diameter with hardly a perceptible scar. If hairs are present, they should first be removed, and after sufficient time has elapsed to note the result the mole itself may be dealt with. Very extensive growths are most readily and speedily removed by the knife when their situation permits of such treatment. It is not wise to use caustics in the treatment of moles, especially in elderly persons, for they may be thus teased into malignancy.

HYPERTRICHOSIS.

Hypertrichosis, hirsuties—in common language superfluous hair—refers in a general way to some abnormality in the length or thickness of the hair, or more especially to its occurrence in undesirable or unusual situations.

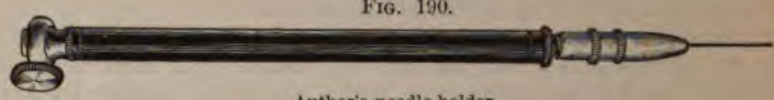
The medical man is practically interested only in the facial hirsuties of women. The character of the growth as regards the amount of hair, its texture, and the locality implicated differs very much in different cases. In rare instances there may be a full beard as coarse as a man's, or the hairs may be fine and comparatively few in number. In the writer's experience the growth is more fully developed on the chin than elsewhere, next on the upper lip, and lastly on the cheeks near the margin of the hair. Often when the beard is tolerably full on the chin there will be but little hair on the upper lip, and then mostly at the corners of the mouth.

Treatment.—The removal of hair by depilatories of various sorts has only the effect of shaving, and is worse than useless. To prevent the capillary growth it is necessary to destroy the hair-papillæ and the hair-bearing surface of the follicle. This is best accomplished by electrolysis. This method was first proposed by Michel of St. Louis for the cure of trichiasis,[1] and was afterward first applied to the facial hirsuties of women by the writer.[2]

[1] *St. Louis Clinical Record*, Oct., 1875.
[2] *St. Louis Med. and Surg. Journ.*, Nov., 1877.

The following account of the electrolytic operation is abbreviated from the writer's *Manual of Skin Diseases*:[1] It is necessary to have a good

FIG. 190.



Author's needle-holder.

galvanic battery, a number of fine needles, a suitable needle-holder, a sponge electrode, and the usual insulated cords. The needles used may be the delicate jeweller's bristles or those made of irido-platinum drawn out to a point. The patient being seated in a reclining chair, facing a good light, the needle attached to the negative electrode is entered into the follicle, the hair being left *in situ* as a guide; after this has been accomplished, and not till then, the patient is told to place a couple of finger-tips on the previously moistened positive sponge electrode.[2] The needle is not withdrawn until a slight frothing is observed around its stem, showing that the electrolytic action has been fully developed; but to avoid shock the positive sponge electrode is first released by the patient, and then afterward the needle is removed, being exactly the reverse of the initial steps. An experienced operator will find no difficulty in introducing the needle directly into the follicle, and he can be assured of this fact by the following circumstances:

1. If the needle miss the follicle and pass into the surrounding tissues, a sharp pricking sensation will be experienced by the patient, but if the instrument be properly introduced into the mouth of the follicle and allowed to sink by its own weight (and on this account a moderately heavy holder is preferred) to the bottom of the canal, no pain will be felt until the contact with the positive electrode occurs.

2. The practised operator will readily detect an unusual resistance if the needle fail to pass down the follicle.

3. In the majority of cases the proper direction of the needle is manifested by the appearance of the sebaceous secretion, and sometimes this is evident immediately upon the passing of the needle, even before the circuit is closed.

As a rule, a few seconds—twenty to forty—suffice for the destruction of the papilla; but this is largely a matter of experience, and depends upon various circumstances, such as the strength of the current employed, the character and situation of the hairs, etc. If the electrolytic action has been properly developed and skilfully applied, the hair will come away with the very gentlest traction of the forceps—a point always to be tested at once; but if force be required for its extraction, it would be a sign that the operation has been ineffectual, and the needle must be reintroduced at once or the process may be repeated at a subsequent sitting. Ten or twelve cells of a freshly-charged twenty-cell galvanic battery may be employed, but after a time the number of cells will have to be increased. A current measurer is convenient, but not absolutely necessary.

[1] Lea Bros. & Co., Phila., 1890.

[2] A better result may be obtained by placing this electrode in a bowl of water, and then directing the patient to place one or more finger-tips in the water.

The amount of pain experienced differs in different people, and also according to the situation of the hairs, but generally a tolerance is soon established.

The immediate effect of the electrolysis is the formation of an urticarial wheal, and also the production of a variable amount of circumscribed congestion and perifollicular exudation; but if the patient is directed to bathe the parts in very hot water, for ten minutes at a time, several times a day after each operation, this local disturbance readily subsides.

When the hairs are closely set, it is not advisable to operate on each one in succession, but they may be gradually picked out here and there at different sittings, until the whole field has been gone over. Thus by the use of hot water to allay inflammation and the selection of different localities for operation the sittings may be more frequent and the work considerably expedited; and, moreover, by using due caution and skill visible scarring may be altogether obviated. On the upper lip, however, where the skin is thin and if the hairs are numerous, minute pits may be produced, and under exceptional circumstances in other situations—as, for example, when the hairs are very coarse and abundant—the same effect may ensue; but it is certainly exceptional. From twenty to sixty hairs may be removed at each operation, and this usually may last from a half to three-quarters of an hour.

ELEPHANTIASIS.

Elephantiasis is an hypertrophy of the skin and subcutaneous tissue due to interference with the lymph-circulation. Sporadic cases are found in nearly all countries, while in some, as China, Egypt, Arabia, and the East and West Indies, the disease is endemic. In the endemic form the malady is ushered in by repeated attacks somewhat resembling erysipelas. The part affected, usually a leg, becomes red, swollen, painful, and the skin is much infiltrated; sometimes vesicles form, with the discharge of lymphatic fluid. The local affection is accompanied by fever, muscular pains, and vomiting. After the acute symptoms have passed away the patient is restored to his usual health, save that the part attacked is slightly larger than before. Such attacks are repeated, and by each the size of the part is increased till a fully-developed case of elephantiasis results. Some of the sporadic cases develop from repeated attacks of true erysipelas, while many cases run a slow and continuous course without fever.

Nearly any part of the body may be affected, but the common sites for elephantiasis are the legs and the scrotum. In a well-developed case the enlargement of the part is enormous, while the normal outlines are lost. A limb is thus rendered unwieldy and useless. The skin may be of normal color or pigmented, smooth or covered with varicose lymphatics and papillary hypertrophies. Where folds come together there may be collections of sodden epithelium and decomposing sebum with a foul odor. Occasionally there is a constant discharge of lymph from a varicose lymphatic. Eczema and varicose ulcers form the most frequent complications of elephantiasis of the legs.

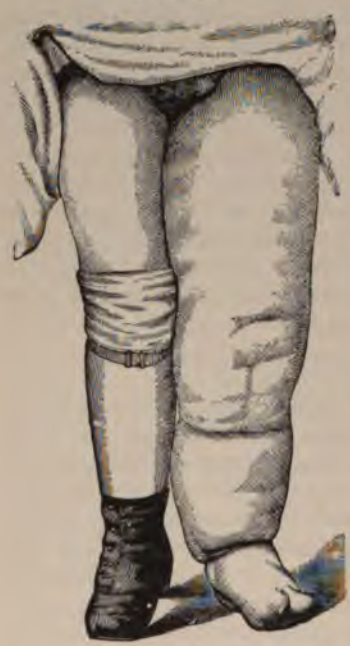
All grades of the disease exist, from a slight enlargement, accompanied by chronic œdema, up to the great deformities described.

A special form of elephantiasis is the lymph-scrotum, in which the enlargement is not very great, but there is marked dilatation of the lymphatic spaces, which may rupture, with the discharge of a milky or serous liquid.

Elephantiasis usually causes no subjective **symptoms** except during the acute attack.

Etiology.—Elephantiasis attacks both sexes and all ages, but is most common in adult males. Congenital cases are reported. Though known in all parts of the world, its development is favored by damp, warm regions near the sea. The occlusion of the lymph-channels, which is the cause of the disease, may be produced by inflammation or may be the result of mechanical obstruction. Thus, elephantiasis may follow chronic eczema or oft-repeated erysipelas, or the chronic stasis of heart disease may play an important part in its etiology. The endemic form of the disease found in the tropics is due to the filiaria sanguinis hominis blocking the lymph-channels.

FIG. 191.



Elephantiasis (after Taylor).

Anatomy.—Anatomically, elephantiasis consists in a great increase in the amount of connective tissue, principally occurring in the subcutaneous layer. The muscles are often degenerated and lost in the fibrous mass. The lymphatics and blood-vessels are enlarged, and the nerves are also sometimes increased in size. Even the bones participate in the increased growth, being either uniformly enlarged or presenting exostoses.

Diagnosis.—In a well-developed case of elephantiasis there is no difficulty in diagnosis. In the earlier stages it is often difficult to distinguish from chronic œdema and scleroderma localized to a part.

Treatment.—No internal medicament has any effect upon the disease. When elephantiasis develops in one residing in a climate where the malady is endemic, a change of residence should be insisted upon.

When the disease affects the genitals, it has been removed by the knife with success in a number of cases. Ligature of the main artery of an extremity is only palliative, and is not now much used, as the same result can be obtained by compression of the vessel. Inunctions of mercurial ointment, with the application of bandages to hold the ointment in place, have been recommended. Good results have been claimed from the use of the galvanic current, the negative pole being applied to the affected part.

The most beneficial treatment thus far suggested when the leg is affected is the application of a Martin's rubber bandage. The skin having been powdered with starch to which a small quantity of salicylic

acid has been added, a thin stocking is drawn on the limb and the bandage firmly and evenly applied from the toes up. At night a flannel bandage may replace the rubber one, thus securing better ventilation.

In some cases the writer has seen marked improvement result from the application of Squire's glycerole of the subacetate of lead. Cloths saturated with the preparation are placed upon the limb, covered with waxed paper, and the whole held in place by a snugly-fitting bandage.

Eczema and ulcers complicating elephantiasis are to be treated just as they would be if existing under other circumstances.

Prognosis.—Though much may be done to prevent the increase in growth, there is no cure for elephantiasis save when the growth is so situated that it can be removed. Though the size of a part may greatly interfere with the comfort of the afflicted person, the disease is not directly prejudicial to health.

FRAMBŒSIA.

Frambœsia, or yaws, is a disease hardly ever found outside the tropics. The malady usually attacks the negro races, whites being generally exempt. The initial lesion is a superficial ulceration without induration which most often occurs on the lips, breast, or genitals. This ulcer heals in two or three weeks, and is followed in about a month by a general eruption of red macules. Most of these soon fade, but here and there one goes on to the formation of a conical papule. It is from these papules that the characteristic lesions of frambœsia develop. After a week the apex of the papule turns yellow, and gradually the papule develops into a nodule with thick, yellow, dome-shaped crust, the nodule being about a quarter inch in diameter. If the crust is removed, a mass of red granulation tissue covered with a white acid secretion is seen, somewhat resembling a raspberry. It is from this appearance that the disease takes its name. In the course of the next month the lesions shrink into brown crusts, which fall, leaving in dark races a pigmented macule. The number of the lesions varies from one or two to hundreds. In unhealthy persons the nodules may break down into deep ulcers. The disease may pass into what is termed the tertiary period, in which gumma-like lesions, ulceration of the pharynx and nares, chronic periostitis, anæmia, etc. are present.

The disease is rarely fatal if properly treated, and it is often noticeable that, though the lesions are severe, there is little disturbance of the general health.

Frambœsia is contagious, being inoculable, flies sometimes acting as the carriers of contagion. The malady is due to a specific virus, though no micro-organism has yet been proved to be the cause of the disease. There are many who contend that frambœsia is only syphilis somewhat modified. All admit that there are many analogies.

In the **treatment** of frambœsia tonics and a nutritious diet, in conjunction with cleanliness, are of prime importance. Many authorities are in favor of the administration of mercury as a curative agent, but all agree that it is to be used with caution. The various ulcers and sores which may form are to be treated by washing with antiseptic lotions and dressing with iodoform.

New Growths.

KELOID.

Keloid is a fibrous new growth of the corium which usually follows injuries. The lesions of keloid consist of variously-sized elevations which rise abruptly from the healthy skin. The integument over such growths is smooth, shining, and somewhat stretched; it may be the hue of the surrounding skin or of a pink color. Not uncommonly dilated vessels may be seen running over the surface. The tumors have various shapes, but usually present claw-like prolongations around the periphery. To the finger keloid is firm, but not hard. The most common site of the disease is the sternum, but it may occur upon any part of the body. One keloid alone is usually present, but if the disease has developed from the scars of a generalized eruption, such as small-pox, there may be large numbers upon the body. In some cases the tendency is to slow but steady progression, but in others, after reaching a certain size, the growth remains stationary. Keloid sometimes undergoes involution; this seems to be most common in young subjects. Very rarely suppuration has occurred in a keloid, and malignant degeneration has been observed. Most keloids are tender on pressure, and in some there is spontaneous pain of a burning or pricking character.

A condition resembling, in many of its aspects, keloid is the hypertrophied scar. This condition is most apt to occur where a wound of the skin has not healed by first intention. There is an over-production of scar-tissue, resulting in a raised, reddish or white, generally smooth and shining cicatrix. If the wound was sutured, there are very apt to be prolongations of the scar about the suture-points which make the hypertrophied scar much resemble keloid.

Etiology.—The negro race is especially prone to keloid, and among them hypertrophied scar is very common. It is very likely that keloid is always the result of an injury, the trauma being so slight as to pass unnoticed in those cases where the disease seems spontaneous.

Anatomy.—Keloid affects the corium, and consists of bundles of connective tissue, running mostly parallel with the long axis of the tumor. The nuclei and spindle-cells are scanty and grouped about the dilated blood-vessels.

Diagnosis.—Keloid is to be distinguished from hypertrophied scar by the fact that the latter never extends beyond the limits of the original scar, while the former always extends.

Treatment.—The removal of keloid by the knife or caustics is unsatisfactory, as the growth nearly always recurs, often in an aggravated form. Probably the best results can be obtained from the use of electrolysis. Only a weak current should be at first used, and then, if the result seems good, stronger currents may be applied. Verneuil has recommended pressure with the elastic bandage, taking care to avoid friction. Vidal advised mincing the growth thoroughly with a knife, attempting to divide all the vessels in the tumor.

Hypertrophied scars should not be excised unless the tissue in which the cicatrix lies is lax enough to allow of easy approximation, as the condition is very likely to recur in wounds which heal by granulation. For this reason the greatest care should be taken to keep the wound

aseptic. If it does not seem expedient to attempt the removal of the scar, it may be rendered less prominent by the use of electrolysis.

FIBROMA.

There are several clinical varieties of fibromata of the skin. The most common form consists of firm, pea-sized nodules situated in the skin of the cheek or nose. Sometimes hairs grow from these. Another form, called achrochordon, develops upon the necks and between the shoulders of elderly persons as small flabby sacs of skin. Fibroma when generalized is called molluscum fibrosum. The individual tumors in this condition may vary in size from a pea to a small orange. They may be imbedded in the tissues or may be pedunculated; they may be soft to the touch or hard. The skin over the tumors may be normal in color or it may have a pinkish or purplish hue. Growing from the tumors a few hairs may be seen, and here and there comedones. Very often it will be possible to find scattered among the other growths little sacs of skin from which the tumors have disappeared. Not infrequently in connection with molluscum fibrosum there exists that condition known as dermatolysis. Under such circumstances thickened folds of skin, loose, flabby, and pendulous, are found. The mass feels soft, the surface is often pigmented, and the sebaceous glands are increased in size. Dermatolysis most often exists about the sides and back of the head, on the back, buttocks, and shoulders. The number of tumors in molluscum fibrosum may vary from a few up to many hundreds.

The **course** of the affection is one of slow progression. The only discomfort the disease causes is by its unsightliness.

Etiology.—The cause of the development of fibromata is unknown. They often occur first in childhood.

Anatomy.—The tumors are, as the name implies, made up of fibrous tissue which springs from the corium.

Diagnosis.—Fibromata are most likely to be confounded with lipomata and sebaceous cysts. Lipomata are not pedunculated, are lobulated, and the skin often presents dimpling. In sebaceous cysts the contents may often be expressed, leaving the mass smaller than before.

Treatment.—The pedunculated fibromata may be removed with the ligature or the galvano-cautery. The growths which are imbedded in the skin, if removal is attempted, should be thoroughly removed, as otherwise they will recur. In the small tumors about the face electrolysis has been used successfully by the writer. The large dermatolytic growths are often very vascular, and when their removal is attempted every precaution to guard against hemorrhage should be used. A number of very large growths of this sort have been removed.

Prognosis.—The tumors of molluscum fibrosum generally increase as age advances, both in number and size. The affection has no effect upon the general health.

NEUROMA.

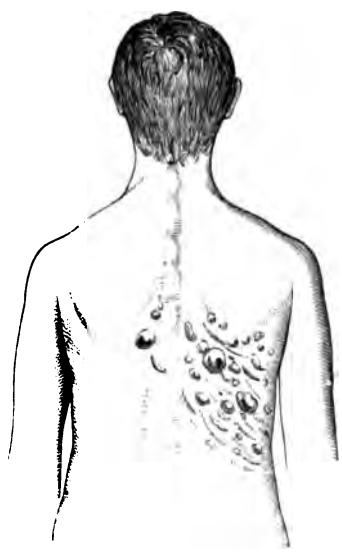
Under the name "neuroma" are described fibrous tumors which have developed from the neurilemma. In most of the reported cases the tumors have been subcutaneous, though in some instances the growths

have really occurred in the skin as flat, firm nodules from a pinhead to a pea in size, arranged in groups, sometimes confluent. There is both spontaneous pain and pain on pressure, which may radiate along the nerves. In two of the reported cases relief was obtained by removing a part of the nerve-supply.

MYOMA.

Myoma of the skin occurs as small multiple growths or as a single larger tumor. The first variety is very rare, only nine cases having been reported. The affection occurs as patches of lenticular-sized tumors, the skin over which may be normal in color or more commonly of a reddish hue. Nearly all the cases have been accompanied by pain, either spontaneous or provoked by pressure. Some of the lesions may undergo involution, but the tendency is to slow progression. The growth is limited to the cutis, and the tumors are made up of smooth muscle-fibres probably derived from the erectores pili.

FIG. 192.



Author's case of multiple myomata of skin.

The large single myomata are not so rare. They occur as various-sized tumors, sessile or pedunculated, chiefly on the breasts and genitals. Such tumors are very slow-growing, and do not, as a rule, cause pain. They are composed of smooth muscle-fibre mingled in varying proportion with blood-vessels, fibrous tissue, or even lymphatics.

The only method of treatment for myomata is ablation, which is often demanded by the pain of the tumors.

ADENOMA.

Adenomata of the skin may arise either from the sebaceous glands or from the sweat-coils. Arising from the sebaceous glands, they are com-

monly found as a congenital affection, developing very often in those presenting mental defects. The lesions are papules from a pinpoint to a pea in size. Many of the papules show telangiectases, which give the lesions a red color, but the tumors may be colorless and semi-transparent. The eruption occupies the middle two-thirds of the face. Frequently a few lesions are present at birth and others gradually develop. The individual adenomata show very little change after they have once developed, but some may undergo involution, leaving faint scars.

Under the title *hydradénome éruptif* Darier has described an affection which he supposed was adenoma of the sweat-coils. The lesions are small tumors at first, of the color of the skin, afterward becoming shining and translucent. Many contain little white milium-like bodies. The most common sites of the eruption are the forehead, the root of the nose, the cheeks, the upper lip, and chin, though any part of the body may be affected. Sometimes the eruption is confluent.

The **course** of the disease is slow, but exacerbations are not uncommon. Microscopically, the tumors consist of prolongations of epithelium coiled on themselves and containing cyst-like spaces filled with a colloid material. From this anatomical appearance the disease has been termed epithelioma adenoides cysticum.

The only **treatment** for these forms of adenomata consists in removing the little tumors with the knife or destruction by the galvano-cautery or electrolysis.

NÆVUS VASCULARIS.

Nævus vascularis is a congenital new growth of blood-vessels in the skin or mucous membranes. These growths may be present upon a child at birth or they may not become manifest till a later period. Vascular nævus is very common. In many cases the mark which is on the child at birth disappears in the first few months of extra-uterine life. On the other hand, the nævus may develop up to a certain point, and then remain stationary for the rest of the subject's life. In still other instances the growth, after having remained quiescent till the child is of some age, suddenly advances with alarming rapidity till great deformity, and even more serious consequences, result. The vascular nævi differ much as to the area they involve. Sometimes they are no larger than the head of a pin, while in other cases a large area of the face or a whole extremity is affected. In some cases several nævi are found grouped along the course of a nerve. The parts of the body most commonly involved are the face, head, neck, and arms, though any part of the skin and the mucous membrane may be implicated.

The clinical picture of nævus vascularis depends upon a number of factors, among which are the size and character of the vessels composing the growth and presence or absence of changes in the other elements of the skin in the affected region. When only the superficial capillaries of the skin are involved there occur larger or smaller spots of a reddish or bluish hue. The shapes of these nævi vary as much as their sizes, and the variations have given rise to special names; thus, a common form is a small central red spot from which branches in all directions red lines, the nævus araneus. Another common form is the port-wine mark, in which a large area of skin is discolored, usually without any change in

its texture. Upon the surface of such an area small erectile tumors may develop. If there be a considerable development of connective tissue, the surface of the affected skin may present little wart-like projections.

Nævi may be made up of vessels larger than capillaries. These growths are prone to increase in size. They may commence in the skin or in the subcutaneous tissue, with secondary involvement of the skin. Such a nævus may first manifest itself as a small red dot resembling the capillary nævus above described. From this beginning the nævus may grow so rapidly as in a few months to involve an extensive area of the body. These nævi occur as more or less prominent rounded or lobulated tumors, the skin over which may be natural in color or of a bluish or red color. Such tumors have an elastic almost fluctuating feel, and may be rid of their contents by pressure, but soon refill. Some of them are pulsating, and in these a distinct bruit may often be heard. If wounded, abundant and alarming hemorrhage will occur, and the same result is sometimes brought about by spontaneous ulceration of the skin over the nævus. This form of nævus is most frequently met with on the back, nates, female genitals, lower limbs, and beneath the lower jaw.

The usual course of these nævi is one of slow progression, but at times they have been seen to shrink and disappear.

As a rule, nævi vasculares are not accompanied by any subjective symptoms. In the larger forms there may be radiating pains from a pressure on nerves. When a nævus in which a bruit is present occurs on the head, the patient may be uncomfortably aware of the sound.

Etiology.—The cause of vascular nævus is wrapped in the same obscurity which envelops the etiology of other congenital new growths. The peculiar arrangement of some nævi along the course of nerves has suggested a neurotic origin. Maternal impressions in their relation to nævi are to be regarded as coincidences. Virchow's idea that nævi are the result of irritation at fissural borders rich in blood-vessels, occurring during embryonal life, may be true, but yet is no real explanation of the cause of the growth.

Anatomy.—The simplest form of vascular nævus is made up of superficial dermal capillaries increased in number and in size. In other cases the growth consists of larger vessels with all their coats preserved. Such vessels may be mostly arteries, or veins may predominate. At times the increased number of vessels is confined to those anatomical sites where they are normally most abundant, as about hair-follicles or sebaceous and sweat-glands; this leads to the formation of a lobulated tumor. In some cases the vessel-walls gradually give away, and we then find a series of intercommunicating spaces formed of fibrous tissue lined with endothelium. This form has received the name "cavernous tumor." At times the cavernous tumor is surrounded by a dense fibrous capsule.

Diagnosis.—There is no other affection which is likely to be confounded with capillary nævus. When there is a tumor, especially if it is subcutaneous, it must be differentiated from other soft forms of tumors, such as lipomata and cysts. The most characteristic sign of a vascular tumor is its sudden fluctuations in size. If the blood be pressed out, the tumor shrinks to insignificant proportions, to swell again as soon as the pressure is removed. A vascular tumor grows more turgid when the

pressure in the superficial vessels rises, as in straining at stool or crying. Some vascular tumors present pulsation and a bruit.

Treatment.—The number of methods which have been used for the cure of vascular nævus is very great. In this place only the most important of these methods will be noticed, and only those which seem to the writer most useful will be dwelt upon.

For the cure of small capillary nævi chemical caustics have long been used. Among the most commonly employed may be mentioned nitric acid, carbolic acid, chloracetic acid, chloride of zinc, acid nitrate of mercury. Probably the most satisfactory agent of this class is the ethylate of sodium. This remedy is applied to the nævus with a glass rod, the application being attended by a good deal of pain. A thin black eschar forms, which separates at the end of a few days. After allowing a sufficient time to elapse for the remaining inflammation to subside, the effect of the operation may be judged. Uusually several applications will be required. When a large port-wine mark is to be attacked, only a small area should be cauterized at a time. The scar resulting from ethylate of sodium is superficial and smooth. When the nævus to be destroyed is only a point or a small spot, a good method is to apply to it the point of a galvano-cautery brought to a red heat. When a port-wine mark is small and so situated that a sufficient amount of skin can be readily spared, excision yields good results; it is speedy, sure, and, if antiseptic precautions are observed, a thin linear scar results. A method which has been much vaunted by some, but which in the hands of good surgeons has often failed, is multiple scarification. The area to be operated upon is first frozen with salt and ice or with a spray apparatus, and then a series of incisions close together, extending through the affected skin, is made. Another series at right angles to the first completes the operation. Only a small area at a time is operated upon. Bleeding is arrested by pressure. The ideal method of treating the capillary nævi, in the opinion of the writer, is the use of electrolysis. Here we have an agent which is more nearly within the control of the surgeon than any of the caustics, and if the operation is properly performed there results a minimum of scarring. This method has certain drawbacks. It is tedious, and if a large area has to be operated upon the endurance of the patient may fail. The operation is somewhat painful, necessitating in children the administration of an anæsthetic; as the operation must be several times repeated this becomes an objection. If the birth-mark is small or if the child is young enough to be held and prevented from struggling, then electrolysis is the best operative procedure. The writer performs the operation in the following manner: A very slim steel needle or a smooth dental broach is fixed by a suitable holder to the negative pole of a galvanic battery. To the positive pole is attached an ordinary medium-sized sponge electrode. The strength of current is such as may be derived from twenty cells of an ordinary battery. The writer judges of the proper strength by thrusting both the needle and the sponge into a basin of water and noting the amount of bubbling produced around the needle. If any vessels can be seen in the nævus, they should first be attacked. The needle is thrust perpendicularly into each, and the sponge applied to some convenient part of the body, thus closing the current. In a short time the vessel changes from

a red line to a white one. The positive pole is now removed and the needle then withdrawn. The operation upon the portion of the nævus where only a diffuse coloration is to be noticed is performed by thrusting the needle into the skin a little deeper than the nævus is supposed to extend. As the action of the current goes forward a white ring will be seen to form around the needle, which in a few seconds attains the diameter of one-fourth of an inch. The exact time at which the action of the current is to be stopped is a matter of experience. If it be continued too long, more destruction is produced than is necessary for the obliteration of the vessels, and more scarring will result. The needle is introduced a number of times each sitting, a sort of tatooing of the surface being done. It is often of advantage to pass the needle just beneath the surface parallel with it, as in this way a larger number of vessels are acted upon at each puncture. For a week or ten days after each operation there will be enough inflammatory reaction to obscure the result. When this has subsided the operation is again repeated as often as necessary. It must be stated, however, that in capillary nævi of any great size it is best to postpone the electrolytic operations until the patient reaches an age when he is willing to suffer the necessarily repeated sittings without an anæsthetic.

In the treatment of those nævi which form tumors of the skin various measures have been advocated. The injection of coagulating substances into the tumor and the passing through it of setons soaked in astringent liquids are mentioned merely to be condemned; while they may accomplish the desired result, they do so no more effectually than other means which are less dangerous. Long-continued pressure by means of properly arranged pads and elastic bands has been successful, but is both tedious and uncomfortable, and, worse still, uncertain. Where the tumor is small excision is very satisfactory, but the precaution must be taken to cut wide of the tumor or we will witness its reappearance. Another method is to pass ligatures, and by trying to strangulate the tumor. This method is especially applicable if the tumor is pedunculated. When a more sessile growth is to be dealt with in this manner, a pin should be thrust under the tumor; a double ligature having been passed at right angles to the pin, the nævus is tied in two parts, the pin keeping the thread from slipping. Of course the same antiseptic precautions are to be taken as in all surgical operations, and an antiseptic dressing must be applied. Many cases of vascular nævus of moderate size can be very successfully treated by ignipuncture. The instrument of choice is the slender point of the galvano-cautery heated to a dull red. This is thrust into the nævus at several points. After sufficient time has elapsed for the subsidence of the consequent inflammation the effect can be estimated. It will generally be necessary to repeat the operation a number of times to secure obliteration of all the vessels. The coagulating effects of the electrolytic needle may also be well employed in the treatment of this form of nævus, and perhaps of all methods offers the best results in a cosmetic way. Duncan of Edinburgh, one of the earliest advocates of electrolysis in nævus, reserves this agent for what he terms the mixed and subcutaneous varieties.

He uses steel needles insulated with vulcanite, the length of the exposed point varying, according to circumstances, from an eighth to

three-quarters of an inch. Both poles are introduced, and in small nævi they are placed parallel and equidistant from each other and from the sides of the tumor; in large nævi the negative needle may be moved from place to place or reintroduced at other points. The punctures should be covered with antiseptic wool and flexible collodion. In large nævi a little can be done at each sitting, but it is best to have an interval of several weeks between the operations.

Other methods of treatment, such as subcutaneous laceration and vaccination, need not be dwelt upon, as the means mentioned are greatly superior.

Prognosis.—The superficial capillary forms of vascular nævus, such as nævus araneus and port-wine mark, in some cases disappear as a child grows older. More often, however, they remain relatively stationary, only increasing as the part upon which they are situated grows. The course of the tumor-like forms is so variable as to make prognosis a matter of impossibility. Occasionally entire disappearance occurs; the growth may remain stationary or it may suddenly increase at a very rapid rate. In view of these facts it is the duty of the surgeon to destroy nævi of this sort at as early a date as possible.

LYMPHANGIOMA.

By the term "lymphangioma" is meant a new growth of lymphatic vessels. Several varieties of the affection are recognized and classifications have been made, some using as a basis the anatomical structure of the growth, others the portion of the lymph-system involved. Only two forms of cutaneous lymphangiomata have been recognized. To one of these Kaposi gave the name lymphangioma tuberosum multiplex. Since that time more extended research has proven pretty clearly that the affection which he thus denominated is not really a lymphangioma, but a tumor connected with the sweat-gland. There remains, therefore, of true cutaneous lymphangiomata only the affection known as lymphangioma circumscriptum, which is a rare affection. The disease first manifests itself, in the majority of cases, in childhood. It may affect almost any region of the body, cases having been reported in which even the mucous membrane was involved. The lesions which form the essential elements of the disease are deeply-seated vesicles with thick walls. These vesicles are not disposed singly, but are aggregated into patches of irregular shape from one to three inches in diameter. Owing to the thickening of the epidermis over the lesions, the patches have a warty look. The vesicles are of the size of a very small pea, colorless or pinkish, and when pricked emitting a clear serous fluid containing lymph-corpuscles. Over some of the vesicles telangiectasic vessels will be seen coursing. An accidental rupture of these may give to the contents of the vesicles a hemorrhagic character. Around a patch of closely packed vesicles will usually be found a few outlying lesions, and it is in these that the above-mentioned peculiarities can best be studied.

The **course** of the disease is a slowly advancing one, with no tendency to heal spontaneously.

Etiology.—No cause for the development of lymphangioma circumscriptum is known. Besnier attaches importance to the fact that some of the reported cases have been associated with venous nævus.

Anatomy.—The growth is composed of flask-shaped chambers lying in the papillary and deeper parts of the cutis, lined with endothelial cells.

Diagnosis.—If the peculiarities of the lesions and the chronic course of the disease are borne in mind, there is no other affection with which lymphangioma circumscriptum can be confounded.

Treatment.—Total destruction is the only treatment which offers any hope of success. Caustics have been used for this purpose, but often the lesions have again returned in the neighborhood or in the original area. In suitable regions the use of the knife, the incision being carried quite far from the borders of the patch, will be found the best treatment. In situations where the knife is not suitable careful destruction of each vesicle with the electrolytic needle is to be recommended.

RHINOSCLEROMA.

Rhinoscleroma is a new growth of the infectious class. The usual site of the growth is about the anterior nares, though cases have been reported in other regions, the pharynx, larynx, and lachrymal sac. As generally seen, the disease first manifests itself as a painless induration of the mucous membrane of the ala or the septum nasi. The induration increases slowly and has no tendency to involution. When well developed the lesions consist of isolated or aggregated flat tubercles of a marked hardness. The skin over these may be normal in color or of a dark, shining red. Often dilated vessels are seen running over the growth. The glands and hair-follicles in the affected skin are lost. In the course of time the whole end of the nose may be involved, the lip encroached upon, and the nares blocked up, thus seriously interfering with respiration. The skin over the tumor is apt to fissure, giving exit to a sticky liquid which dries into crusts, but ulcers do not form. There is no spontaneous pain, but after pressure aching occurs. The affection runs a course of many years without causing deterioration of the general health. When removed the growth usually rapidly returns.

Rhinoscleroma is a disease of adult life which is confined to rather narrow geographical limits, being most common in Russia and Austria. The active cause of the malady is a capsulated bacillus which some have thought to be really the pneumococcus. Microscopically, the growth is like a granuloma, except that no true giant cells are found. The corium is principally affected. The diseases which most resemble rhinoscleroma are syphilis, epithelioma, and keloid. Syphilis and epithelioma ulcerate early, while in keloid there would usually be a history of a previous scar.

Treatment.—Permanent removal of rhinoscleroma has never been accomplished, as the tumor always re-forms. Lang obtained a good result by the use internally and locally of salicylic acid. Ten grains were administered by the mouth three times a day, and hypodermatic injections of a 1 per cent. solution were made into the growth, while an ointment of the drug was applied in the nares on cotton plugs and a salicylic acid snuff used. Unless to save the life of a patient from some intercurrent accident, such as obstruction to respiration, operative treatment does not seem to be indicated.

LUPUS ERYTHEMATOSUS.

Lupus erythematosus is a cellular infiltration of the skin, characterized by erythematous scaly patches of various sizes and shapes, generally decked with grayish or yellowish adherent scales, and displaying a tendency to superficial scarring.

There are several clinical varieties of the disease recognized by authors. By far the most common is the *discoid* or *circumscribed* form, in which the primary or eruptive lesion is from a pinhead to a pea in size, slightly raised, and which presently becomes covered with an adherent scale that dips down into a dilated sebaceous duct. These spots may be isolated or grouped, few or many, but gradually, by peripheral extension and coalescence, they come to make variously sized and shaped, erythematous, scaly patches that are characteristic. The patch is pinkish, reddish, or purplish in color, and the surface is in some cases covered with scanty adherent scales, or else with thick, yellow, and sebaceous-looking crusts, or in still other instances the lesions are frankly erythematous and free of scales. The patch spreads peripherally, and finally exhibits a depressed, atrophic centre, with a raised border, studded with comedones or showing small patulous openings. There may be one or more such lesions present, varying in size from a pea to that of the palm.

The **progress** of the disease is usually very slow, often extending over years, but occasionally the evolution is much more rapid. After a while the affection ceases to spread, and comes to a standstill, or involution may be complete, and nothing remain but a superficial or deep, usually punctiform, scar. When hairy parts are affected, the hairs fall out as the result of follicular atrophy. The usual seat of the disease is upon the face, especially over the bridge of the nose, and also the tip and alæ, on the cheeks, eyelids, scalp, and ears. One of the most characteristic types of the affection is exhibited in the so-called butterfly or bat-like form, produced by coalescence of patches on the bridge of the nose and on the cheeks under the eyes. Other parts of the body may be affected, and attention has been called to lupus erythematosus of the hands and feet, and also of the mucous membrane of the mouth.

The subjective **symptoms** are not marked, and at the most consist of slight burning or itching. In the ordinary forms of the disease, to which the description just given applies, the patients are in the enjoyment of general good health.

In the form of the disease called lupus erythematosus disseminatus there are many aggregated or discrete, usually erythematous, primary eruptive spots, which, unlike the discoid variety, spread by the multiplication of these lesions, and not by their coalescence; and thus by the appearance of new patches among the older large surfaces may be involved, and almost any part of the body occupied by the eruption.

Grave constitutional and local disorders may complicate this affection, and a fatal termination has ensued in a large proportion of the cases. The writer has reported two instances of this formidable disease, both ending in death.[1] There is a strong suspicion in the writer's mind that these cases, like some of the discoid forms, are really examples of cutaneous tuberculosis.

[1] *Journ. Cutan. Dis.*, Dec., 1889, and July, 1892.

Crocker[1] describes a telangiectatic and a nodular form. In the first-named variety there is a chronic, erythema-like redness, due to dilatation of vessels, accompanied by considerable infiltration and later by superficial scarring. It may be single, but usually occupies both cheeks. The second, or nodular, variety does not present a very definite clinical picture, and would seem to consist of brownish-red nodules, not unlike lupus vulgaris, but which from their course and general behavior bear a resemblance to lupus erythematosus. This same excellent observer in a recent article[2] relates a number of cases in which lupus erythematosus imitates more or less closely such different affections as psoriasis, lichen planus, erythema, lupus vulgaris, etc.

Etiology.—Lupus erythematosus is much more common in women than in men, and usually first makes its appearance between the ages of eighteen and forty, although a few cases in children have been recorded. The etiology of the disease is very obscure, but it is likely that both debilitating influences and local irritations predispose to it. For example, Hutchinson says a history of phthisis in the family is often obtainable, and it would seem that uterine derangements and chlorotic states often exist as antecedents or complications; and, moreover, heat and cold and the various agents that dispose to seborrhœa are undoubted exciting causes.

Morris is emphatic in his belief that it is in no way akin to the tuberculous process, but concludes that lupus erythematosus must be regarded as a chronic inflammation of the skin, local in its origin, and generally local in its course, unconnected, as far as our present knowledge goes, with any underlying constitutional state. It is true that certain physicians do not share this opinion, and look upon lupus erythematosus as directly or indirectly tubercular; still by far the greater number of dermatologists regard it as a local disorder.

We have, however, to explain the disseminate erythematous lupus of Kaposi, a malady that in the beginning is of the ordinary type, but which later becomes widely spread, is complicated by formidable general and local symptoms, and not uncommonly ends in death, but, as stated before, this type is probably tuberculous.

Finally, it remains to point out that there are a number of morbid processes that closely simulate lupus erythematosus which are really anomalous forms of cutaneous tuberculosis; and this fact has undoubtedly given rise to much of the confusion that exists on this subject. These forms will be considered presently under Diagnosis.

Anatomy.—The changes found in tissues affected with lupus erythematosus are of an inflammatory nature. Collections of cells are seen around the follicles and glands of the skin, the vessels are dilated, their walls proliferating, and around them are extravasations of round-cells. The gland-cells take part in the proliferation, producing seborrhœal plugs. Externally the inflammatory products may be absorbed, leaving the skin normal, or degeneration of the cells occurs with atrophy of the organs of the skin and the formation of scar-tissue.

Diagnosis.—The diagnosis of lupus erythematosus in its ordinary discoid form presents no great difficulty, particularly if the following

[1] *Diseases of the Skin*, 2d ed., 1893.

[2] "Lupus Erythematosus as an Imitator, etc.," *Journ. Cutan. Diseases*, Jan., 1894.

salient points be taken into consideration, viz., the age of the patient—between eighteen and forty-five; the sex, generally women; the situation of the disease, usually the upper part of the face, and generally the ears; and, finally, the defined border studded with comedo plugs, the adherent scales, and the central scarring.

Acne rosacea at times bears a close resemblance to lupus erythematosus, but the presence of papules and pustules, and the ramifying vessels in the former, with the defined edge, the adherent scales, and the cicatriform centre of the latter, should prevent confusion; besides, in lupus erythematosus the eruption is often found on the ears. Lupus vulgaris, with its brownish infiltrations deep in the skin, its suppuration, ulceration, and thick cicatrices, should be easily excluded. Moreover, lupus erythematosus is a disease of adult life, while lupus vulgaris dates from childhood.

Chilblain, psoriasis, ringworm, and some forms of syphilis more or less closely resemble lupus erythematosus at times, but due attention to the features of the disease already given should prevent error in diagnosis. There is no question that lupus erythematosus has heretofore been confused with the erythematoid lupus vulgaris of Leloir, and this, besides, has caused many to believe that the former was in reality a cutaneous tuberculosis; but notwithstanding the close resemblance[1] time and attentive observation will clear up the diagnosis.

There are undoubtedly other forms of skin tuberculosis that bear a near likeness to lupus erythematosus, as in the writer's case recently reported,[2] and in their early stages at least it will be necessary to resort to the microscope for a definite demonstration.

Treatment.—The internal treatment of the disease consists for the most part in the employment of remedies to improve the general health or for the correction of obvious complications. Some observers think they have seen good results from the direct action of certain drugs on the disorder itself. For this purpose arsenic, ichthyol, iodide of starch, and phosphorus have been recommended.

Bulkley[3] claims brilliant results from the last-mentioned agent given in solution as follows:

℞.	Phosphorus,	gr. vj;
	Absolute alcohol,	ʒxxx.

To be dissolved with the aid of heat and agitation, and then mixed, while still warm, with the following mixture, also warm:

Glycerin,	℥ixss;
Alcohol,	℥iss;
Essence of peppermint,	ʒss.

The dose is fifteen drops in water, taken quickly to prevent oxidation, three times a day after meals, and gradually increased to 45 or 50 drops.

The local treatment is, however, of far greater importance, and,

[1] For full description see the section on Lupus Vulgaris.
[2] *Am. Jour. Med. Sci.*, April, 1894.
[3] *Am. Jour. Med. Sci.*, April, 1893.

according to the symptoms present in a given case, may be soothing, stimulating, or destructive. The calamine-and-zinc lotion, with tar, is an excellent preparation when a soothing remedy is required:

℞. Zinci oxidi, ʒss;
Pulv. calaminæ præp., ℈iv;
Glycerini, ʒj;
Liq. calcis, ʒvij;
Liq. carbonis detergentis, ʒiss.—M.
Sig: Shake. Local use.

By frequently mopping on some such soothing and astringent lotion it is often possible to cause the disappearance of acute attacks of the disorder.

Where the infiltration is moderate, but of somewhat longer standing, a lotion first suggested by Duhring is very serviceable:

℞. Zinci sulphatis;
Potassii sulphureti, āā. ʒss
Aquæ rosæ, ʒiijss;
Alcoholis, ʒiij.—M.
Sig. Mop on morning and evening for ten or more minutes at a time.

An ointment of salicylic acid ½ drachm, sulphur 1–2 drachms, add vaseline one ounce, thoroughly rubbed in twice daily, is also to be advised in a similar class of cases.

In old, deeply-infiltrated patches Unna's salicylic plaster mull may be used as a preliminary to other measures.

Hutchinson and Crocker recommend moderate frictions with benzolin, followed by a weak iodoform or boric-acid salve. The latter writer says it should be used at night and calamine lotion applied during the day, but if irritation results the frictions should be limited to two or three a week.

Pure carbolic acid sometimes acts very efficiently, but as it is quite painful it is best to apply it to limited patches at a time.

Other valuable topical remedies may be referred to in addition; for, as Kaposi remarks, no one application can be depended upon for all cases or even for the same case at different periods of its progress. Hebra recommended for comparatively recent small lesions, situated on thin parts of the skin, that the surface be rubbed with the spirit of soap, followed by some emollient salve. The green soap alone may be used for this purpose, or it may be spread as a plaster on flannel. Simple collodion, or collodion to which 10 per cent. of resorcin has been added, may also be recommended. Kaposi speaks highly of emplastrum hydrargyri (German formula). In cases having hard, horny scales Veiel prefers chloracetic acid. It is put on with a glass rod, and soon produces a white eschar, and into this is bored a pointed glass rod dipped into the acid. For large surfaces this writer prefers pyrogallic acid in a 10 per cent. salve, which is kept on for three or four days until a superficial brown eschar results, which in turn is covered with an iodoform bandage till it sloughs off.

The method of multiple linear scarifications is of especial value, and is to be preferred to the use of strong caustics. For this operation one may employ any of the knives made for this purpose, preferably Pick's modification of Veiel's, Squire's, or Van Harlingen's. Parallel incisions are made that are about one-sixteenth of an inch apart, and these are crossed by another series, and even a third. The parts should be first frozen with rhigoline spray, and the hemorrhage that follows may be checked by pressure with absorbent cotton and the wound dressed with iodoform. It is well to operate on limited patches at a time, and usually it is necessary to repeat the operation several times. Vidal employs a single blade of peculiar construction, and makes what is termed quadrilateral linear scarifications.

Many years ago the writer employed and recommended electrolysis in suitable cases, and an extended experience has confirmed him in his good opinion of this method. It is especially useful in chronic infiltrated patches, and if carefully done need not produce any great amount of scarring. Even in tolerably recent lesions a more or less superficial tattooing with the electrolytic needle will cause their disappearance without any noticeable destruction of the skin.

Both the galvano-cautery and the Paquelin cautery have also been successfully employed.

Prognosis.—Prognosis should always be guarded, as the disorder runs a very variable course, and a plan of treatment that is very successful in one case will be of no effect in the next. Some of the superficial forms of the disease are quite amenable to treatment, and in the more chronic patches, even if a cure cannot always be accomplished, decided amelioration may be secured. Relapses may be expected. The disseminated form is of grave import.

LUPUS VULGARIS.

Lupus vulgaris is an exceedingly chronic tubercular disease of the skin or mucous membranes that generally commences in childhood, and consists of a cellular new growth in the corium, and is characterized clinically by papules, tubercles, or infiltrations, with subsequent formation of scars. The affection begins as pinhead-sized brownish-red, yellow, or even bright red spots deeply imbedded in the skin, the color of which can be paled, but not entirely effaced, by pressure. These primary lesions may be elevated, depressed, or on a level with the skin. At this stage of the process the macules may be quite visible to the eye, but inappreciable to touch, and they may be discrete or closely aggregated into flat infiltrations. These macules may also be detected at the periphery of old patches and as redevelopments in scar-tissue.

Very gradually translucent, so-called apple-jelly-like nodules develop, which eventually, in months or years, form one or more dull-red elevated somewhat scaly patches (lupus tuberculosus). The lupus growth is of soft consistency, not hard like the nodule of syphilis, and can readily be broken down by slight pressure with a probe. In this form the disease continues for a longer or shorter period, but finally certain retrogressive changes occur. The lupus tubercles (or lupoma), may undergo resorption and leave in their wake an atrophied glossy and

scaling surface looking not unlike a burn, and usually presenting a raised edge made up of pale or reddish nodules (lupus exfoliativus, lupus non-exedens). In the majority of cases the lupus infiltration breaks down and ulceration occurs (lupus exulcerans). The ulcerations are not often painful, are irregular in shape, more often shallow than deep, present a well-defined border and a red, bleeding surface. The pus-secretion is not profuse, but sufficient to form dirty, reddish-brown crusts. When healing takes place the resulting scars are generally thick and distorted. This is the type of lupus usually met with in practice. (Plate III.)

The course of lupus is always exceedingly chronic, oftentimes years elapsing before any great amount of surface is involved, but eventually its ravages may be appalling. The onward march of the disease is by no means steadily progressive. As the result of various influences, both local and constitutional, its progress may be delayed for a while, to be succeeded after a variable period by renewed activity, and thus with an advancing line of ulceration in one place and cicatrization in another, or a renewal of the lupus in parts already scarred over, the disorder as a whole discloses a striking clinical picture.

Lupus presents considerable variety in its clinical expression, due in part to the regions attacked, the constitutional peculiarities of the sufferers themselves, and the complications that may arise. It must be remembered, however, that these different forms are accidental developments, and, moreover, that it is no uncommon thing to find various phases of the lupous process transpiring at one and the same time on the same patient.

Lupus is not usually symmetrically disposed, although it may become so accidentally. The disease may occur in a single patch or less frequently in several; on the other hand, there may be many foci of disease (lupus disseminatus). If exuberant granulations form in the lupus patches, it is known as lupus hypertrophicus, and when the disease spreads by an extending border or the coalescence of one or more patches it goes by the name of lupus serpiginosus. By lupus papillomatosus is meant a papillary overgrowth, such as may happen on any ulcerated surface, and in this disease is most often encountered on the extremities.[1] *Lupus verrucosus* is regarded by Unna as identical with verruca necrogenica, and is considered both by McCall Anderson and Crocker as a form of scrofuloderma.

Leloir[2] describes a form of lupus vulgaris under the title of lupus vulgaris erythematodes, which the writer believes is very common, but is usually confounded with lupus erythematosus. Somewhat abridged, Leloir's description of erythematoid lupus vulgaris is as follows: it occurs on the face, rarely on the trunk, and never on the limbs. It appears as a large or small plaque, occasionally in one, two, or three patches, usually on one cheek, but often invading the nose and both cheeks in a symmetrical manner, just as in butterfly lupus erythematosus. The affected surface has a more or less lively redness, which disappears in part

[1] The writer has shown elsewhere (*Archives of Dermatology*, Oct., 1880) that under the general designation of papilloma cutis writers have included a great variety of clinical forms, but which are in reality secondary to syphilis, lupus, etc.

[2] *Traité pratique de la Scrofulo-tuberculose*, Paris, 1892.

PLATE III.

LUPUS VULGARIS (TAYLOR).

(To face page 434.)

on pressure. The surface is seen to be marbled by a sort of quadrillage of a red-brown or violet, in the midst of whose meshes may be found small white or yellow points. Fine vascular arborizations may also be noted, especially at the periphery. The erythematous surface is sometimes here and there lightly desquamative, and even covered with small lamellar crusts, which may have a seborrhœic aspect, particularly at the border of the plaques.

The plaque is slightly elevated at the margins, and, when sufficiently old, depressed in the centre. Notwithstanding these striking points of resemblance between lupus erythematosus and erythematoid lupus vulgaris, it often happens that if the skin is stretched at the level of the zone of the active extension of the disease it is possible to make out the small yellow miliary nodules of lupus vulgaris, which will present the usual physical characteristics of such nodules. These lupus tubercles are very difficult to find, however, and not always present at a given time. Other points that establish the true lupus nature of this affection are the profound infiltration of the plaques, and the fact, upon which Leloir lays much stress, that there is a tendency to cicatrization at the periphery —an event, he claims, that never takes place in lupus erythematosus.

The face is the usual site of lupus, especially the nose and cheeks, and also the ears. The trunk and extremities are also attacked; the hands and feet not infrequently. The forehead, the chin, the penis, and the palms are practically exempt. It is noteworthy that exposed parts are for the most part implicated.

Lupus of the mucous membranes is not often primary, although Bender has shown that this occurs oftener than has been generally credited. As a rule, the involvement of the mucous membrane of the eye, nose, mouth, larynx, and vagina is secondary to the disease on the parts adjacent or elsewhere on the body.

While the cartilage may be destroyed by lupus, as seen especially on the nose and ears, it is doubtful whether the bones are ever affected except in a secondary way.

Various **complications** may arise in the course of lupus. Swelling and suppuration of the lymphatic glands contiguous to lupous patches are not uncommon, and chronic enlargement of the parotid has been often noted. Leloir regards the lymphatic-gland involvement as due to secondary tubercular infection, and not merely as irritative. Erysipelas not infrequently supervenes, and sometimes has a decided curative effect. Recurrent attacks of lymphangitis and erysipelas often lead to chronic hypertrophy and a condition of elephantiasis of the lower limbs. Abscesses and all manner of inflammatory conditions, caries, periostitis, osteitis, with contractions and mutilations of various degrees, may also complicate lupus, although Crocker says that such accidents are not the direct result of the lupus, and rarely occur except in those markedly strumous. It is nevertheless true that lupus may coexist with tuberculous lesions in joints, bones, and glands. It remains to add that there may be grafted on this already terrible disease one more terrible, and that epithelioma often develops on a lupous patch or in the scar of a preceding lesion.[1]

[1] Dubois-Havenith observed the development of epithelioma in 5 out of 118 cases of lupus.

In the great majority of instances, aside from the result of interference with local function, lupus seems to be without prejudicial effect on the general health. As will be shown presently, however, secondary tubercular infection is more common than is generally supposed.

Etiology and Pathology.—Lupus vulgaris is rare in this country, as compared to the continent of Europe, and even here it is more frequent at the seaboard with its foreign population than in the interior and among the native born. For some unknown reason it attacks females oftener than males.

Lupus usually begins in the first decade of life, and rarely commences after puberty, although there are some exceptions to this rule. Owing to greater crowding and other favoring influences it is more apt to be found among the poor than the well-to-do, although no social class is exempt.

Careful inquiry shows that a history of phthisis may often be elicited among other members of the family of a lupous patient, and abundant statistics are at hand to prove that secondary tubercular infection is unusually frequent.

Leloir regards the enlargement of glands contiguous to lupous patches as often distinctly specific, and not merely irritative. Although presenting marked clinical differences, the connection between the so-called scrofuloderma—and, in fact, the state generally—is undoubted.

Many carefully recorded cases are in evidence to show that lupus may result from direct inoculation. For example, in a case observed in my clinic by Dr. Hersman a woman who accidentally made a blister on her cheek while cooking was inoculated by tuberculous sputum from her husband's handkerchief, with the result of producing a typical lupus vulgaris.

As lupus usually occurs in exposed spots, it has been thought that cold acted at least as a predisposing cause, but it is likely that the greater liability of the face and hands to infection would be a more satisfactory explanation. Lupus has been noted to start in scars, wounds, herpetic vesicles (Crocker), and other breaks of continuity in the skin.

Lupus vulgaris is now generally conceded to be essentially a tuberculosis of the skin, and the anatomical changes that occur are due to the presence of the tubercle bacillus. The bacilli, however, are very sparse, and often a large number of sections must be examined before their presence can be demonstrated.

Anatomy.—If one examine a fresh nodule of lupus, the epidermis will be found normal. In the papillary body or deeper in the corium a miliary tubercle is found sharply differentiated from the surrounding tissues. This is formed by a round-cell infiltration which commences around the vessels of the corium. The central portion of such a mass of round-cells undergoes coagulation-necrosis, while at the periphery are new-formed vessels. In the central part of the mass the so-called giant-cells are to be found. By proper staining in sections of lupous tissue tubercle bacilli can be demonstrated, generally lying in the periphery of the giant-cells, but they are very few and often many sections will be examined before they are found. By the growth of the lupous tubercles and by the formation of new ones the deeper parts of the skin and the special organs which it contains are gradually destroyed. Even muscle

and cartilage come to be involved. The epidermis over the tubercles may become gradually thinned till it gives way and an ulcer is formed, or it may take on an exaggerated growth over the corium, the resistance of which is diminished, and carcinoma may thus be engrafted upon a lupous base.

Diagnosis.—In typical cases the diagnosis presents few difficulties: the history of the case, the disease beginning early in life, its great chronicity, and the presence of the characteristic reddish-brown, apple-jelly, readily broken-down tubercles are not easily misinterpreted. There are several ulcerative diseases, however, that at times bear a tolerably close likeness to lupus. The tubercular and serpiginous syphilides are especially to be differentiated. Lupus begins in early life, and is apt to be definitely localized. Syphilis as usually seen dates from adult life, and the lesions are more widely dispersed. Lupus is chronic in its course; syphilis much more rapid—doing more harm, in fact, in six months than lupus in as many years; or, as Payne has it, lupus is to syphilis as the hour-hand is to the minute-hand of a clock. Lupous nodules are set deeper in the skin, are reddish-brown, and readily break down; the tubercles of syphilis are pinkish-red, firmer, and less irregular in outline. Lupous tubercles often redevelop on the scar left by the disease; syphilitic tubercles rarely if at all. The ulcers of lupus are not so deep and clear cut as those of syphilis. The secretion from lupous ulcers is scant and inodorous; from syphilis, purulent, abundant, and offensive. The crusts of lupus are thin and reddish; the crusts of syphilis, thick, greenish-black, and have the oyster-shell arrangement. The scars of lupus are thick, band-like, and adherent; in syphilis they are thin, soft, and movable (except in the neighborhood of joints). The osseous tissues are not implicated in lupus; they may be attacked in syphilis. Finally, it is always possible to apply the test of treatment.

Epithelioma might form a source of some confusion, but it must be remembered that lupus begins in early life; cancer of the skin is a disease first occurring in middle age. Lupus will probably exhibit several points of ulceration, and the lupous nodules may be demonstrated; in epithelioma the ulceration starts from a single point, and no apple-jelly lesions are to be seen. In lupus the ulceration extends more superficially than in epithelioma. In lupus the edges of the ulcer are soft and regular, while the edges of the epitheliomatous ulcer are hard and everted, and the base is uneven and secretes a thin sanguinolent fluid. It is to be remembered that epithelioma may develop on a lupus.

The ulcerations left by broken-down glands and the accompanying chronic inflammation of the skin in their neighborhood may suggest lupus, but the absence of lupous nodules, the presence of sinuses and enlarged glands elsewhere, would be sufficiently distinctive.

Lupus erythematosus is usually symmetrical, commences later in life, and is much more rapid in its course than lupus vulgaris; besides, there are no ulcerations and no apple-jelly nodules in the first-named trouble, and the scales are fatty and dip down into the sebaceous orifices.

Crocker[1] regards tuberculin injections as a valuable aid in diagnosis. Two milligrams may be first tried, and then .005 or even .01 gr., and the

[1] *Diseases of the Skin*, 2d ed., 1894.

smaller the dose that produces local and general reaction the more likely is the disease to be lupus vulgaris. A large dose (.01) may perhaps produce slight local reaction in lupus erythematosus, but not in syphilis or epithelioma. It is of no diagnostic value in lepra or scrofuloderma, because, according to the same authority, the distinction between lupus vulgaris and the latter is of no practical importance, while lepra may react altogether too violently.

Acne rosacea and leprosy should also be considered in establishing a definite diagnosis.

Erythematoid lupus vulgaris bears a strong likeness to lupus erythematosus, but the presence of lupous nodules and the other features already mentioned above should be sufficient to prevent mistakes.

Treatment.—Persons suffering from lupus may often be greatly benefited as to their local condition by appropriate hygienic and general treatment; that is to say, while no manner of internal medication will cause the disappearance of an existing infiltration, it may be made more amenable to appropriate local measures, and to display less destructive tendency and less proneness to relapse. On the other hand, cases are not infrequently encountered in which there is no apparent demand for internal medication, the patients possessing perfect general health. The two remedies of greatest value are cod-liver oil and iodine or iodide of potassium. The oil should be pushed to the limit of tolerance. Iodide of potassium is regarded by many as of especial value, and Liveing speaks well of iodine in two- or three-drop doses, combined with Fowler's solution or the syrup of the iodide of iron.

The specific treatment of lupus with tuberculin has not come up to the expectations of its early advocates, nor, on the other side, is it absolutely as valueless as some have presumed. Morris in his recent text-book says that a course of tuberculin injections should be preliminary to the treatment of lupus by any of the local methods, as it seems to make the disease more amenable to these measures. Crocker says that it will remove the fibroid thickening that is often seen about the lips and where there is much lax tissue, and that, moreover, after as much lupous tissue has been removed by erasion as possible it will dissipate some of the tissues that has escaped destruction from without, and in this way secure a longer period of abeyance and a greater degree of permanent cure.

Thiosinamine has recently been recommended by H. von Hebra for a similar purpose. As to its permanent effect upon the disease, very little can be said at present, but there seems to be little doubt as to its value in removing cicatricial thickenings, and thus restoring the mobility of joints and other parts. Intercurrent attacks of erysipelas have also a decided influence over the lupous process, as the writer can testify from experience.

The action of drugs having a marked local reaction perhaps produces similar results. Quite recently Bramwell[1] has got surprising amelioration in lupus from thyroid feeding.

Whatever may be the future of the internal treatment of lupus, it remains that local measures of relief are paramount in importance. The object of local treatment is to remove the diseased tissue, and, inci-

[1] *Brit. Med. Journ.*, Apr. 14, 1894.

dentally, to accomplish this with as little deformity as possible. The measures, medical and surgical, recommended to attain these desirable ends are almost numberless. In the choice of a method the surgeon must take into account the stage, extent, and location of the disease, and must be well acquainted with the effects that will follow upon a particular operation.

In a small proportion of cases soothing remedies are useful and tend to promote involution of the disease. On non-ulcerated surfaces Crocker recommends the familiar calamine-and-zinc lotion, and where the skin is unbroken the writer has seen benefit from the unguentum vaselini plumbicum, to which has been added about 10 per cent. of aristol or iodoform, preferably the former. In superficial forms of the disease Brooke's[1] ointment does excellent service, and acts much better than the usual mercurial plasters :

℞. Hydrarg. oleatis (2½–5 per cent.), ℥j ;
Acidi salicylici, gr. x–xv ;
Ichthyolis, ♏xv ;
Olei lavandulæ, q. s.—M.

Sig. Rub in with steady friction ten to twenty minutes morning and evening.

The skin must not be broken by the application ; if, however, this should occur, the salve must be diluted or the parts dressed with a little boric-acid salve until it has re-formed.

When the infiltration is considerable, Riehl first cleanses the parts with soap and water, and then brushes on a solution of caustic potash, 5 parts, in distilled water, 10 parts. This is left on until the epidermis becomes macerated, when it is washed off with water, and the iodoform is thickly strewn on and kept in place for several days.

Quite recently Mr. Lane[2] has called attention to the value of sulphur in the treatment of lupus, the drug being used in powder or as an emulsion with glycerin, and Harrison recommends saturating the lupous surface with a solution of hyposulphite of sodium (40 gr. to 1 oz.), followed by a lotion of five drops of undiluted hydrochloric acid to the ounce of water. It is said that nascent sulphurous acid is produced in this way in the tissues.

Salicylic acid was introduced some years ago by Marshall, and of late has been much lauded by Unna and Jamieson. It may be used, as suggested by Treves, made into a cream with glycerin, to which is added a small amount of creasote, or in the shape of Unna's plaster mulls. These plasters may be renewed once, or, where there is much exudation, twice daily. They are made of different strengths, and Jamieson recommends that the treatment should be begun with as strong a plaster as the part will bear. The incorporation of the creasote with the salicylic acid materially lessens the pain. The results obtained are often very satisfactory, but, as in most other procedures, new nodules are apt to develop, and these must be destroyed in the manner presently to be described. Among the more decidedly caustic remedies may be mentioned Cosme's paste as modified by Hebra, nitrate of silver in stick or solution, a paste of chloride of zinc, and lactic acid. This latter may be used for small ulcerations and lupus of the mucous membrane.

[1] *Brit. Jour. Dermatology*, May, 1890. [2] *London Lancet*, April 7, 1894.

Pyrogallic acid has a selective action for lupous tissue, and if not used over too extensive a surface gives excellent results. It may be applied as a 10 per cent. ointment or plaster mull, or, as employed by Besnier, as a saturated solution in ether. In the latter case it should be covered with traumaticine, and the operation repeated until all nodules have disappeared.

White and Hyde in this country speak highly of the use of bichloride of mercury in solution or ointment of the strength of one or two grains to the ounce. Hyde says that this treatment is "in many cases brilliantly successful," but the writer has met with no such results.

A 10 per cent. solution of permanganate of potassium painted on daily, or every other day, is recommended by Schultz. The nodules break down under these pencillings, and, it is claimed, can be readily wiped away with absorbent cotton.

Although the various procedures related above have their place at one time or another in the treatment of lupus, and under some circumstances are to be preferred, it is nevertheless true that the mechanical means of treating the disease have largely superseded them.

The range of employment of excision is small. Its use is mostly limited to small patches, or it may be more boldly used in situations like the limbs or trunk where a scar is unimportant, and where skin-grafting after Thiersch's method may be employed. Besnier is much opposed to bloody operations in lupus, fearing general tuberculous infection, and therefore advocates the use of punctate and linear operations with galvano-cautery knives and points of various shapes. The Paquelin cautery can also be employed for this purpose.

Multiple punctiform scarification is now but little used, either as an original procedure or as supplementary to erasion. Linear scarification, which consists in making a series of parallel cross cuts from $\frac{1}{16}$ to $\frac{1}{8}$ inch in depth, with the object of destroying the nutrient vessels of the part, is a far superior operation, and, while excessively tedious, is capable of producing very satisfactory results, although relapses are just as common after it as from any other operation. Fox says that for ulcerating lupus of the nose it is superior to other methods, as it is not apt to be followed by any deformity.

Electrolysis,[1] which the writer has used many years, gives good results in limited patches. The single needle is preferable to the flat plate of Lustgarten.

Probably the most thoroughly trustworthy and universally practicable procedure in the largest number of cases is by erasion with the sharp spoon or dermal curette, as originally advised by Volkmann. Local anæsthesia may be produced or the patient put under ether. The hand soon learns to distinguish between healthy and diseased tissues, especially as the latter come away rapidly. Hemorrhage is easily controlled by pressure with absorbent cotton. The after-treatment of the scraped surface varies with different operators. Volkmann was in the habit of making multiple punctures, so as to ensure complete destruction of all suspicious points. Crocker's plan where there is much cicatricial tissue is to mop on strong carbolic acid, or, if the disease is on the limbs, to apply strong sulphuric acid with a piece of wood, and then neutralize

[1] *Manual of Skin Diseases*, 1890.

with bicarbonate of soda. Boric lint or sal-alembroth wool is then bandaged firmly on to stay the bleeding, and replaced in a few hours with wet boric lint covered with oil silk, and after a day or two the wound is dressed with boric-acid salve. This same excellent authority states that he gets better results where tuberculin has been injected as an after-treatment till the wound heals. Mr. Morris says that Sir Joseph Lister, after scraping and the cessation of hemorrhage, fills up the holes with fuming nitric acid, followed presently by a neutralizing solution of soda. The wound is then dressed in the usual way. T. C. Fox uses a cream of chloride of zinc in spirit for the same ends and Jamieson goes over the surface with a probe on which has been fused some chromic acid—a plan of which the writer can speak highly.

Jarisch first recommended a 10 per cent. pyrogallol salve after curetting, to be followed in some days by iodoform, and when healing began the application of mercurial plaster to secure a good scar. G. H. Fox uses a much stronger salve—25 to 50 per cent.—as it shortens the duration of the treatment, and is decided in his recommendation of this mixed method.[1] In the treatment of small patches the writer has been in the habit of using a thorough electrolysis, followed by curetting and the subsequent application of chromic acid. It is even well in very large patches to first electrolyze the borders before curetting.

Recurrent nodules may be destroyed in a variety of ways—viz. by electrolysis, the dental burr of Fox, the double screw of Morris, or by boring in with a match dipped in acid nitrate of mercury or the crayon of nitrate of silver.

Prognosis.—A very guarded opinion must be expressed in regard to the prognosis of lupus, for under any form of treatment now known relapses of the process are the rule. Naturally also, the various circumstances of age, location, acuteness, extent, and duration must be taken into account. The results of treatment are more satisfactory in elderly people than in the young, and limited superficial areas of the disease may be permanently cured. Although lupus is exceedingly chronic in its course, often lasting twenty or thirty years, it is rarely inimical to the general health, certainly in this country, but it would seem from foreign statistics that general tubercular infection is more frequent than was formerly supposed.

SCROFULODERMA.

The most frequently encountered form of scrofuloderma has its origin in the lymphatic glands in the neck, and more rarely in the axillary and inguinal regions. The glands may be felt under the skin as numerous, tolerably firm, and movable bodies, which grow but slowly and are always indolent. Sometimes several glands attain a considerable size—an inch or more—or a conglomeration of glands may be detected, but, it is said, without becoming fused or matted together (Eve). The glands may remain as indolent nodules for an indefinite period, or they may undergo resolution without suppuration.

Suppuration is, however, the usual termination of the process, the overlying skin meanwhile becoming thinned and of a violaceous color. When the abscess bursts it emits a thin, curdy pus, more or less mixed

[1] For an elaborate account, see Leloir.

with blood. Sinuses and fistulous tracts form, the skin is undermined and perforated, and strumous ulcers are developed.

The ulcers are oval or linear in outline, presenting purplish and undermined edges, and the floors of the abscesses are covered with pale, unhealthy granulations. The secretions from the ulcers form thin, light-colored crusts. The cicatrices that result from the healing process are bound down to the underlying tissues, ridged and knotty, and often hypertrophic. The course of the affection is exceedingly slow, ulceration and repair going on hand in hand for months.

There is also a variety of scrofuloderma—the so-called scrofulous gumma—which begins in the form of bean-sized nodules that gradually enlarge to hazel, or walnut-sized tumors, and are unaccompanied by subjective symptoms. They may or may not suppurate; in the former case there will be present typical strumous ulceration, or, on the other hand, their contents may be resorbed. These gummata may also occur along the course of the lymphatics of a limb (Hallopeau).

To be thoroughly consistent and in accord with modern pathological ideas it would be well to include under the general head of tuberculosis of the skin not only the scrofulodermata, but lupus, as well as tubercular disease of the skin proper; but, although both etiological and anatomical identities must be recognized, at the same time wide clinical divergencies must be acknowledged, and for this reason in a work of this sort it is wiser to adhere to the older classification.

Old people who have been scrofulous in childhood may also develop cutaneous senile tuberculosis, and the ulcers thus produced may undergo a papillomatous transformation, the so-called lupus verrucosus. Indeed, it is now generally acknowledged that this latter condition, the "scrofuloderma verrucosum" of Anderson, is not a true lupus vulgaris, but consists of warty patches in which the miliary nodules of lupus cannot be demonstrated.

Associated with the ordinary expressions of the scrofulodermata may be found lupus vulgaris, tuberculous dactylitis, and certain forms of cutaneous disease, as lichen scrofulosus, and various pustular eruptions (Duhring).

Etiology.—It is held to-day that scrofula is due to the presence of the tubercle bacillus, although the clinical manifestations are quite different from those seen in tuberculosis of the skin and in lupus vulgaris. The disorder is observed in both sexes. It is very common among negroes in this country. Scrofula is a disease of early life, although it may occur in aged people. A favorable condition of the system for the development of scrofula may result from hereditary influences or may be acquired by various direct and indirect means—*e. g.* unwholesome food, exposure, the depressing effects of constitutional diseases, such as exanthemata, and, finally, the exciting agency of chronic inflammation and local injury.

Diagnosis.—Scrofulous ulcerations are to be distinguished from those of syphilis by the presence of concomitant symptoms of scrofula and absence of those of the last-mentioned disease, by the history, the course, the location, and, finally, by the ulcer itself, with its violaceous border, watery secretion, thin crusts, and the non-infiltrated borders. Lupus vulgaris with its apple-jelly nodules should also be differentiated.

Treatment.—The constitutional treatment of the scrofulodermata should be directed to the improvement, in every way possible, of the patient's nutrition.

Cod-liver oil, malt, iron, especially the syrup of the iodide, the hypophosphites, and the lactophosphate of lime are all valuable remedies. Arsenic is praised by Buchner and Eve. Good nourishing food, appropriate exercise, well-ventilated sleeping apartments, residence in the country or at the sea-shore, together with all other suitable hygienic measures, are of the utmost importance.

Treves very wisely states that in treating any case of gland disease the first rule is to remove all sources of peripheral irritation—viz. disorders of the eye, mouth, pharynx, or skin. To promote resolution this authority highly recommends the unguentum plumbi iodidi.

Ringer, Crocker, and others advise sulphide of calcium for the multiple cold abscesses. Crocker especially recommends chaulmoogra oil in the form of an emulsion in from 10- to 30-minim doses, and an ointment externally. G. H. Fox has seen good results from the internal use of iodide of starch in strumous subjects. Broken-down glands, sinuses, and ulcers should be thoroughly curetted, touched with pure carbolic acid, and afterward dressed with iodoform. Treves uses a fine point of the thermo-cautery, which is thrust through the skin into the substance of the gland, and is passed in several directions through the gland-tissue before it is withdrawn. Excision gives good results in suitable cases; that is, in those instances in which there are present two or three movable and superficially seated glands, or in chronic circumscribed enlargements that have resisted other methods of treatment (Eve).

Lupus verrucosus is best treated by the application of Unna's salicylic-acid plaster mulls, or a paste of salicylic acid and glycerin, together with curetting. The raw surface may be dressed with an emollient ointment, to be followed by the application of mercurial plaster.

TUBERCULOSIS CUTIS VERA.

Persons suffering from general tuberculosis are occasionally subjects of tubercular lesions at the muco-cutaneous outlets—viz., the vulva, anus, lips, etc.—whence they may spread to the contiguous skin. They occur in the form of shallow, painless, discrete ulcers with slightly thickened borders and reddish-yellow floors covered with a thin secretion. The ulcers do not heal, but gradually, extend, and thus may coalesce with others to form serpiginous tracts.

FIG. 193.

Verruca necrogenica.

VERRUCA NECROGENICA.

The anatomical wart commences as a small flat infiltration on the knuckles or between the fingers, and soon becomes pustular. Finally, the surface becomes irregular and warty, and presents the type of a papilloma. It is not uncommon on the hands of those engaged about the dissecting-room or in making post-mortem examinations. It is said to be clinically and anatomically identical with lupus verrucosus and Riehl and Paltauf's disease, next to be described.

TUBERCULOSIS VERRUCOSA CUTIS.

Under this designation Riehl and Paltauf have described a form of cutaneous tuberculosis occurring in individuals exposed to animal infection—namely, butchers, coachmen, cooks, and others. It is rare on the palms, but is met with generally on the backs of the hands and the interdigital spaces, just as in the anatomical tubercle. It occurs in large and small warty patches, round, oval, or serpiginous. These patches extend peripherally, and are surrounded by a bright erythematous areola, within which may be detected a zone of small scattered pustules seated on a brownish or livid infiltration. The middle of the patch is made up of uneven and warty growths, which are covered with crusts, and, as is usual with such formations, pus may be made to well up from between the papillomata. The affection disappears by flattening of the central verrucæ and drying up of the pustules: a pliant, thin, sieve-like scar results. Tubercle bacilli were demonstrated in the granulation tissue and in the giant and epithelial cells of the caseous nodules. Similar cases have since been observed abroad and in this country. Under the title of tuberculosis papillomatosa cutis Morrow[1] gives an exhaustive account of a case in which exuberant papillomatous growths covered the face, and in which the microscopical examination established the fact of tubercular infection.

ANOMALOUS FORMS OF CUTANEOUS TUBERCULOSIS.

It is now a recognized fact that the tubercular contagium may be directly transferred to the skin in a variety of ways, but the writer is assured that we are by no means as yet fully acquainted with all the clinical types of the disease. For example, Hyde claims that there is an acne group of tuberculoses that result from the common habit of picking and scratching the scalp, face, or beard in those who are the subjects of pulmonary tuberculosis. The writer[2] has recently called attention to a form of cutaneous tuberculosis in a young man which closely simulated lupus erythematosus and erythematoid lupus vulgaris of Leloir (see under Lupus Vulgaris), but in which tubercle bacilli were to be demonstrated.

The treatment of the various forms of cutaneous tuberculosis is essentially that of lupus vulgaris.

LEPRA.

Lepra, or leprosy, is a chronic, endemic, specific disease, characterized by various alterations in the tissues and organs of the body, and

[1] *Journ. Cutan. and Genito-urinary Dis.*, vol. vi., 1888. [2] *Am. Jour. Med. Sci.*, April, 1894.

usually ending in death. Although all forms of the disease are due to one and the same cause, it is convenient on clinical grounds to divide leprosy into (1) the tubercular or nodular, (2) the anæsthetic or nervous, and (3) the mixed. Nodular leprosy is most common in Europe, nerve leprosy in the tropics, while the mixed form is less frequent generally than either of the others.

No initial lesion has been detected in leprosy, and the method of introduction of the disease into the body is unknown. The incubation period varies considerably, and usually extends over some years, perhaps two, three, or even as many as ten or more, but from the very nature of the case this is a matter difficult of exact determination. There is also a prodromal stage and a period of eruption, but as these differ somewhat in the two principal varieties they will be considered under their respective headings.

TUBERCULATED LEPROSY.—After a variable period of general malaise, dyspepsia, constipation, or diarrhœa, vertigo, profuse perspiration or local anidrosis, general infection of the system is declared by a chill and a rise of temperature to 103° or 104° F. These symptoms

FIG. 194.

Tuberculated leprosy (after Danielson and Breck).

may last days, weeks, or months before the leprous exanthem makes its appearance. This eruption is usually situated on the face, ears, trunk, and extremities, and consists of erythematous, infiltrated, hyperæsthetic, sharply-limited macules of a reddish-brown color, and varying in size from a bean or less to several inches in diameter.

The first crop of eruptions may fade away, to be followed, with renewed febrile exacerbation, by others, or they may change to a permanent brownish-red stain; and these various processes may continue for months without further alterations. The spots are often hyperæsthetic

at first, and later may become anæsthetic; and this latter condition may be detected in apparently normal regions of integument.

Finally, however, tubercles in the shape of pale-red, very small elevations, which enlarge to the size of a pea or filbert, of a brownish color, make their appearance. These may occur anywhere, but the face, penis, scrotum, breasts, and limbs are the most usual sites of development. The individual lesions may attain great size, or by coalescence may form larger, irregular, nodulated masses. On the other hand, the original erythematous patches may become profoundly infiltrated, brownish elevations.

The leprous deposit also occurs on any of the mucous membranes, and produces quite characteristic symptoms when the cavity of the nose and the larynx are involved. In most cases, owing to the excessive deposit of leprous nodules and thickenings on the face, the countenance assumes the well-marked leonine expression, giving an aspect of brutality to the unfortunate sufferer that is repulsive in the extreme. As a result of various circumstances the course of the tubercles may present very different terminations. Sometimes the lesions undergo involution, leaving brown maculations in their wake or atrophic scars, or, what is very usual, ulceration may take place, the ulcers being superficial, indolent, and healing only after a long time, often only to break down again. The lymphatic glands become enormously enlarged. From time to time acute exacerbations occur, and new tubercles appear after each attack, but usually with diminishing frequency as the disorder advances, to cease altogether after five or six years (Hillis). After months or years, with progressive emaciation, the patient will succumb, either directly from extensive ulcerations, from interference with the respiratory function, or is carried off by some intercurrent affection or from disorders of internal organs due to invasion of the lepra bacillus. The features of the anæsthetic or nervous form of the disease may at any time be superadded, thus producing what is called the "mixed variety." Nodular leprosy lasts, on an average, about nine years.

Anæsthetic Leprosy.—Febrile symptoms are absent in nerve leprosy as a rule, but the patient complains much of uncomfortable feelings of chilliness, and suffers more or less from ill-defined gastric and other disturbances. Lancinating pains are felt in various parts, together with sensations of numbness or burning. Muscular weakness is an early symptom. Numerous small blebs make their appearance on the extremities, which later in the disease assume considerable proportions. After a time erythematous spots and patches come out on the trunk, limbs, and face. They have a certain resemblance to the lesions of erythema multiforme, but are larger and more irregular. The macules are one or two inches in diameter, and later by coalescence may cover large areas, the first spots disappearing and reappearing, and new lesions developing from time to time. It is said that the patches are rarely insensitive at this time, but that the secretion of sweat is absent. Anæsthesia is often apparent in places where no noted changes have occurred in the skin, especially regions supplied with cutaneous nerves from the ulnar and peroneal. In the spreading stage of the malady the spots enlarge peripherally, the borders are raised, studded with papules or vesicles, and the centres become hairless, wrinkled, dry, atrophic, and

covered with white furfuraceous scales. In addition to the well-marked anæsthesia that is now present, large bullæ form, mostly on the extremities. Owing to the presence of leprous deposits in the nerves, these

FIG. 195.

Anæsthetic leprosy (after Hyde).

latter, especially the ulnar, become enlarged, and can be plainly felt under the skin. Muscular atrophy is a prominent symptom, the wasting being first visible in the thenar and hypothenar eminences, and involving the muscles of the hand, forearm, and even the upper arm.

Motor paralyses, especially of the facial nerve, may be combined with the sensory, and after a while the mimic muscles of the face are implicated. Finally, after the various local processes have been long established—*e. g.* anæsthesia, analgesia, and atrophy—the osseous system becomes involved, and there arises the combination of symptoms called lepra mutilans. According to Bidenkap, the affection of the bones may develop in two different ways. Sometimes the deep ulcers left by the bullæ extend and cause profound destruction of the connective tissue, muscles, and fasciæ, and in certain situations, such as the ankles, wrists, and feet, bones are laid bare and caries appears. As the wounds are not painful, they are often neglected, and large parts of the bone may be destroyed, the articular cavities are opened, and spontaneous amputations occur. In other instances, after the anæsthesia has become pronounced, swellings will appear around the phalanges and the metacarpal and metatarsal bones, which will finally turn livid, fluctuate, and burst, and the denuded bones may be seen or felt, and finally be cast off.

Gradually, as the case advances, the symptoms of general marasmus

supervene, and the patient dies from exhaustion or else is carried off by some intercurrent disease. In a few instances the disease may be arrested after having progressed to a certain extent, or even after marked changes have taken place. Also, as in the tuberculated form, after a time the lepra of the nerves may become complicated with the tuberose variety. The duration of the anæsthetic or nervous form of leprosy may be from eighteen to nineteen years.

MIXED LEPROSY.—As already stated, in a minority of cases the features of tuberculated and anæsthetic leprosy may be conjoined. This state may begin with one form or the other of the two chief types of the disease, or it may present both forms from the beginning, in which case its progress is more rapid.

Etiology.—Leprosy is found in all parts of the globe, in all latitudes, and under the most diversified conditions of soil, food, and habits of life. At the same time, it is worthy of comment that nerve-leprosy is more prevalent in tropical countries, while the nodular form is met with in colder regions. Leprosy is rare in children, and is more common in males than in females.

There is much difference of opinion as to the contagiousness of leprosy, some authorities of large experience affirming and some denying this quality of the disease; but when we remember its bacillary nature, the clinical evidence of its inoculation by vaccination (Arning), and its probable propagation by the many intimate contacts of life, there is good ground for accepting an affirmative position on this question. In the same way, the possibility of its transmission by heredity has been both accepted and disputed. On the whole, however, it must be confessed that the reasons for believing in its direct parental transmission are sufficiently strong, especially when the unusually long period of incubation is considered. It is only right to state that good observers believe that only a predisposition is inherited, and that the opportunity for inoculation is afforded by the necessarily close relationship of family life.

It is a curious fact, according to Bidenkap, that leprosy is rare in cities, but common in the country, and this not only in Norway, but in other parts of the world.

As regards its geographical distribution, leprosy is endemic in Norway, Iceland, to a less degree in some portions of Southern Europe, in Africa, Asia, the islands of the Pacific, South and Central America, Mexico, and in the West Indies. On our own continent there is a leper settlement in New Brunswick, and it seems that there was a leper hospital in New Orleans in the latter part of the last century. In recent years a number of cases have been reported as occuring in Louisiana and South Carolina; besides, the disease is known to exist among Norwegian immigrants in the North-western States and among the Chinese on the Pacific coast. A few instances are recorded of persons in the United States afflicted with leprosy who have never in any way been exposed to the disease. White declares that if the authenticity of such cases be established, it would give color to the supposition that the disease may have a sporadic origin, but it is likely that in some manner exposure has occurred.

It is now conceded that the direct exciting **cause** of leprosy is the bacillus discovered by A. Hansen in 1874, notwithstanding the fact that

we are ignorant of its method of attack, and experimental incubation and bacteriological investigation have thrown but little light on the subject.[1]

Anatomy.—Under the microscope the nodules of leprosy are found to be made up of granulation tissue which originates in the corium. Large cells are present, the lepra-cells, which are thought by Neisser and Thin to be exudation-cells which are enlarged under the influence of the bacilli that they contain. There are also giant-cells, lying mostly at the periphery of the nodule. In the nerves the process begins as a round-cell infiltration in the perineurium, which as it increases leads to an irritation of the nerve-fibres with hyperæsthesia, and finally to an atrophy of the axis-cylinder with anæsthesia.

The bacilli of lepra are found in the lesions of the malady either enclosed in the cells or lying free, often in little masses. Though these bacilli have been discovered in all the primary lesions, they have not been demonstrated in the secondary lesions, such as bullæ and diseased bones. There is a difference of opinion as to whether the bacilli occur in the blood. The lepra bacillus is smaller than the tubercle bacillus and of more irregular shape, often presenting slight enlargement of the ends. It can be demonstrated in secretions from ulcers or in sections or scrapings from affected tissues by staining with carbol-fuchsin and decolorizing with nitric acid.

Diagnosis.—In countries where leprosy prevails as an epidemic the prodromic symptoms are always likely to arouse suspicion, but where the disease is occasional they are apt to be confounded with malaria or rheumatism until the appearance of the more distinctive features of the disease, such as anæsthesia and leprous macules, puts the diagnosis at rest. It is quite possible to mistake macular leprosy for exudative erythema and the erythematous syphilide, but in both these conditions there is no alteration of cutaneous sensibility—that is, hyperæsthesia or anæsthesia—and the appearance of the lesions is different; besides, as regards syphilis, there would at this time be other symptoms present.

Tubercular syphilis and nodular leprosy bear a close resemblance if considered superficially, but the tubercles of lepra have especial sites where those of syphilis are rarely found, their course is slower, and anæsthesia may be present. The nodules of lupus have a more chronic history, a dissimilar course, and a different arrangement. In ulcerative lesions of the palate and nose the history of the case and the concomitant symptoms must receive due weight in reaching a conclusion.

Leprosy should also be differentiated from syringomyelia, leucoderma, morphœa, pemphigus, and progressive muscular atrophy. Examination for the lepra bacillus should always be made.

Treatment.—Whatever theory may be maintained as to the contagiousness of leprosy, there is no doubt of the advisability of enforcing segregation of all lepers. The wisdom of this course has been repeatedly demonstrated, and nowhere more satisfactorily than in Norway. When practicable, infected persons should be removed from districts where the disease is endemic and put under the best possible hygienic condi-

[1] Campana and Ducrey have succeeded in cultivating bacilli apparently similar to those of lepra.

tions. A generous diet with a good wine is advised by Hutchinson, and appropriate tonic remedies should be given as demanded.

The so-called specific treatment is far from encouraging, and the results obtained are by no means uniform. There are two remedies, however, that have stood the test of time, and, although not radical in their results, have proved most satisfactory in a variety of ways. These are chaulmoogra oil and gurjun oil. They may be used both internally and locally. Chaulmoogra oil should be administered in capsules, beginning with three minims after meals thrice daily, and gradually increasing to the point of tolerance, which, however, is soon reached. An ointment of the oil made with an equal quantity of lard should be thoroughly rubbed in for two or three hours daily, preceded when necessary by a bath. Gurjun oil may also be employed in the same manner, and is held in high esteem by many practitioners. Tilbury Fox recommends the following formula:

℞. Ol. gurjun, ℥v;
Tr. quillæ, ℥iss;
Pulv. tragacanthæ, ʒij;
Ess. limonis, ♏xx.
Tr. limonis, ʒj;
Aquæ, q. s. ad ℥x.—M.
Ft. emuls.
Sig. A teaspoonful to a tablespoonful twice daily.

For local use a liniment may be made of equal parts of the oil and lime-water.

Piffard and G. H. Fox praise strychnia in the treatment of leprosy, and Unna lauds ichthyol. The latter also uses a salve of ichthyol, chrysarobin, pyrogallol, and salicylic acid, rubbed up with vaseline, for application to the lesions. Morris says that arsenic is sometimes of marked value in skin leprosy. Arning advises salicylic acid, 10 per cent. in oleic acid, and also thinks favorably of salicylate of soda.

Leprous ulcerations should be treated on general surgical principles. Massage and nerve-stretching are to be employed in suitable cases. Warm sulphur baths are useful and agreeable. Incidental symptoms, fever, diarrhœa, should receive symptomatic treatment.

Prognosis.—The prognosis is unfavorable, most cases terminating fatally in the course of years. Anæsthetic leprosy admits of a better prognosis than the tubercular form. The mixed form is most rapidly fatal. It is a possibility that any variety of the disease may be arrested in its course, or even exhibit some improvement in its established symptoms, but such cases are excessively rare.

MYCOSIS FUNGOIDES.

This rare disease may occur in two forms. In one form the affection commences as an erythematous or eczematous condition of the skin. In time variously-sized, irregular, sharply-defined, reddened plaques form, which are infiltrated and accompanied by burning and itching. These plaques may disappear, but return at the same sites or on previously healthy skin. The disease may remain in this stage for months or years,

but eventually tumors form. These may spring from the erythematous plaques, or more rarely from the healthy portions of the skin. The tumors vary in size from a pea to an orange; in color they are dusky red, bluish, or more rarely yellowish. The tumors are firm to the touch, but not hard. They may disappear in a few days, leaving no trace, or an irregular cavity filled with unhealthy granulations may form by ulceration. The tumors may form on any part of the body, even the mucous membranes. In a case of the writer's there were quite large tumors upon the palms.

In the second form of mycosis fungoides tumors form without the preliminary erythematous stage.

The **course** of mycosis fungoides is one of progressive cachexia. In only two cases has a cure been reported. The fatal termination may occur in six months or it may be deferred fifteen years.

Etiology.—The disease does not appear to be contagious. Most of the cases have been in males over thirty years old. Although a variety of micro-organisms have been observed in the affected tissues, none has yet been shown to have a causative relation to the disease.

Anatomy.—The tumors are made up of small round cells lying in the interspaces of a delicate reticulum. The growth was formerly regarded as a sarcoma, but is thought to be a granuloma.

Diagnosis.—In its erythematous stage mycosis may greatly resemble eczema, but the patches are more defined, more infiltrated, and less weeping than in the latter disease. After the tumors have formed the disease may resemble generalized sarcoma or leprosy.

Treatment.—Up to the present time no treatment has proved of much avail, although Köbner reports a case apparently cured by hypodermic injections of arsenic.

Locally, a great variety of agents have been employed, such as pyrogallol, ichthyol, etc. The writer secured excellent results in a recent case by application to the tumors of unguentum vaselini plumbicum with aristol, a drachm to the ounce. The itching may be greatly diminished by painting on a paste of oxide of zinc, half an ounce, with two ounces each of mucilage of acacia and glycerin, and 2 per cent. of carbolic acid. In the case referred to the administration of thyroid extract seems to be doing good.

Prognosis.—The prognosis is bad. The cases in which the formation of tumors is the first evidence of disease run a more rapid course than the cases in which there is an erythematous stage.

CARCINOMA CUTIS.

Carcinoma of the skin occurs as scirrhus and epithelioma. SCIRRHUS is rare, and is usually secondary to some deposit in other tissues, such as the breast. This form of cancer in reality often affects the subcutaneous tissue more than the true skin. In its etiology and anatomy it does not differ from scirrhus affecting other organs. Two varieties of scirrhus of the skin are recognized, the lenticular and the tuberose.

Carcinoma lenticulare begins as small shot- or pea-sized, firm nodules imbedded in the skin. The color of these nodules varies from a light pink or purple to a deep red. Their number is variable, sometimes

reaching to the hundreds. Besides the nodules in the skin, some seated in the subcutaneous tissue can often be felt. The growths in the skin are often situated on a dusky red or violaceous area of skin, which is occupied by a firm infiltration, over which dilated vessels may be seen coursing. The indurated area is usually sharply defined from the surrounding tissues. The hardening of the tissues may extend over a large portion of the body, as the thorax or abdomen, and by the stiffening which it causes interfering with motion. To this condition the name "cancer en cuirasse" has been applied. The lymphatics adjacent to the affected region become involved, and by the pressure of the growth upon the vessels œdema develops. As the disease develops the nodules coalesce, break down, and form ulcers which may fungate. The patient becomes cachectic, and may die from inanition or from a secondary cancer of some of the internal organs. (Plate IV.)

Carcinoma tuberosum first develops as pea- to egg-sized masses in the subcutaneous tissue. The number present may be very great, almost the whole surface being involved. As the nodules increase in size the skin over them becomes stretched, red, and shining, and eventually breaks down, leaving fungating ulcers. The tendency of this form of cancer is toward a rapidly-fatal termination.

Formerly a melanotic cancer of the skin was described, but this is now recognized as a sarcoma.

No treatment has ever availed anything in the cure of either form of carcinoma of the skin above described. The only thing for the surgeon is to endeavor to make the condition of the patient as bearable as possible.

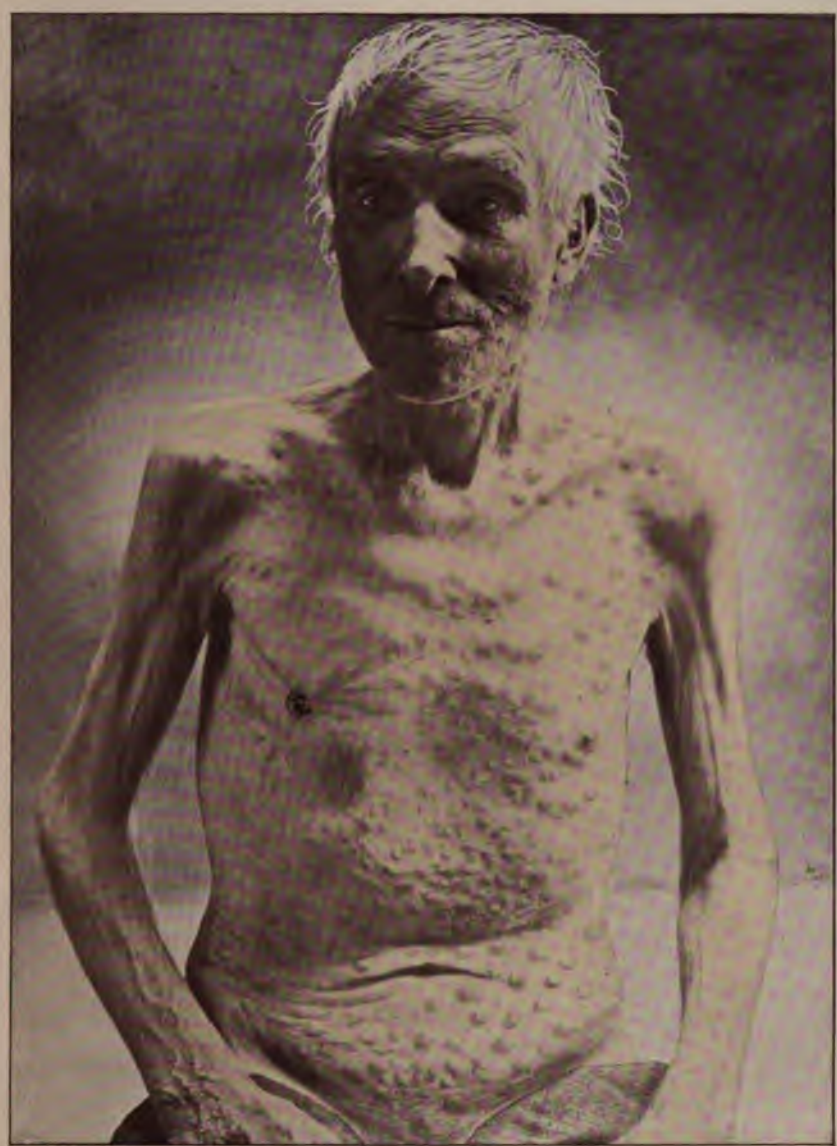
EPITHELIOMA.—The clinical appearances presented by epithelioma vary according to the stage of the disease, its situation, and its anatomical peculiarities. It is usual to describe these variations under three heads—superficial epithelioma, deep-seated epithelioma, and papillary epithelioma.

The superficial form of the malady often first appears as yellowish or reddish, sometimes warty, papules of the size of a pinhead or a little larger. Several such papules may coalesce to form a small lobulated tumor over and around which dilated vessels may be seen. At other times the origin of this variety of epithelioma may be a wart, mole, or a flat infiltration of the skin. After a variable time, though usually not for years, a crust forms upon the lesion. When this is removed a shallow, red, superficial ulceration is exposed, the edges and base of which present a thin though firm induration. The ulceration gradually extends both peripherally and in depth, and the induration grows more marked. After the sore has existed for a long time large areas may be destroyed, all the tissues down to the bones being eaten away, and even the bones themselves being attacked. There is no tendency to involvement of the lymphatics, the disease remaining wholly local. When life is destroyed it is because a vital organ has been involved or by a gradual exhaustion of the powers.

As a general thing, in this form of epithelioma in the earlier stages pain is not pronounced, but in the latter course of the affection this symptom may add greatly to the evils of the patient's situation.

The superficial form of epithelioma occurs most often upon the face,

PLATE IV.



Author's Case of Carcinoma Lenticulare.

(To face page 452.)

though it may be found upon other parts of the body. It is this form of epithelioma which has been called by English surgeons rodent ulcer. For a long time there has been a dispute as to whether rodent ulcers are to be regarded as epitheliomata. This question is now almost unanimously settled in the affirmative. Rodent ulcer is to be regarded as an epithelioma which presents the clinical peculiarities of being extremely slow in growth, not, as a rule, painful, and with little tendency to new growth as compared to the amount of destruction.

The deep-seated epithelioma may develop from the superficial form, but more commonly it commences as an infiltration set deep in the skin. The growth may in the beginning lie in the subcutaneous tissue, or it may project above the skin as a round or flat or lobulated tumor. The skin over it is reddish or purple, and dilated vessels are often seen running over the surface. The tumor is very hard to the touch, and, though at first freely movable over the deeper structures, in the course of time it becomes firmly adherent. Ulceration is the ultimate result of the morbid process. The appearance of the ulcer differs much in different cases. Generally the edges are everted, irregular, infiltrated, and of a livid color, while the floor is uneven and may be covered with a crust. There is a thin, viscid discharge which becomes purulent and offensive if the necrosis is rapid.

The course of this variety of epithelioma is much more rapid than the superficial form. The lymphatics become involved, cachexia is established, and the patient dies in the course of a few months or at most at the end of three or four years. This form of epithelioma is painful, often severely so, from the first.

The common sites for deep-seated epithelioma are the lower lip, the tongue, and the external genitals, though it may occur upon any part of the body.

In either one of the above described forms of epithelioma the papillæ may become greatly hypertrophied, giving to the cancer a peculiar appearance to which the name papillary epithelioma is applied. Sometimes the enlarged papillæ are present from the first; this is especially apt to be the case if the cancer has originated from a wart. The papillary epithelioma may be sessile or pedunculated. Its color is usually a bright red, and the tumor bleeds easily. Between the papillæ fissures form, from which issues a sticky, sanguinolent, and offensive discharge. The base upon which the papillæ are situated is infiltrated. In the course of time the tissue breaks down, with the formation of an ulcer which pursues the usual course of an epitheliomatous ulcer.

Etiology.—Heredity plays a smaller part in the etiology of cancer than was at one time supposed. In only about 5 per cent. of epitheliomata can such an influence be traced. Cancers of the skin, like carcinomata of other organs, are in some way intimately associated with the retrogressive changes of declining life. Thus rarely does an epithelioma of the skin occur before the fortieth year. Epitheliomata are prone to form at points which are subject to constant irritation; epithelioma of the lower lip is common among pipe-smokers. Certain occupations predispose to epithelioma, because they afford means for local irritation; thus we find that epithelioma of the scrotum is common among chimney-sweeps and workers in tar. We have seen how often

epitheliomata start from warts and moles. Other neoplasms, such as cutaneous horns, sebaceous cysts, and scars, are frequently the starting-points for these growths.

To-day the idea that cancer is of parasitic origin is rapidly gaining ground. It is, however, evident that for cancer to attack the organism something more than the inoculation of the parasite is necessary—namely, predisposition; for, though auto-inoculations are not rare, inoculation from a diseased animal to a healthy one even of the same species has rarely if ever succeeded.

Anatomy.—Epitheliomata consist of epithelial plugs which grow downward into the skin and tissues underlying it, forming an alveolar structure in which the epithelial masses are separated by bands of connective tissue. The growth may originate from the glands of the skin or from the interpapillary processes. Generally the outer layer of one of the epithelial processes consists of cylindrical cells, internal to which are polygonal cells, while in the centre cornified cells are arranged in concentric layers, the so-called epithelial pearls. The blood-vessels run in the interlobular tissue. The septa between the lobules, as well as the tissue surrounding the tumor, are the sites of a small-cell infiltration. The anatomy of rodent ulcer, according to Thin, differs from epithelioma in the following particulars: The nuclei of the cells are fairly uniform in size, the protoplasm is scanty and not granular, and the cell-wall not discernible. The cells never enlarge into the flat horny cells of epithelioma, never form nests, and do not retain the dye of eosin.

In the epithelial cells many observers have described structures which they have thought were the parasites of cancer. Recently Ruffer, Foà, and Plimmer have described a parasite consisting of a central corpuscle or nucleus not staining with basic aniline colors, surrounded by a clear protoplasm, the whole enclosed in a distinct capsule.

Diagnosis.—The surest way of making a diagnosis of epithelioma is by submitting portions of the tumor to a microscopic examination. Clinically, epithelioma must be distinguished from lupus, syphilis, innocent papillomata, seborrhœa, and rhinoscleroma. Lupus develops in most cases before the age at which we find epithelioma; there is no induration, the lesions are multiple, the discharge is more purulent, and not sanious or offensive, and the apple-jelly nodules are usually to be seen around the edge of the affected parts.

Syphilitic tubercles and ulcerative processes are to be differentiated from cancer by the history of the case, the absence of pain, and the more rapid evolution of the lesions. Syphilitic tubercles are grouped and ulceration will begin at several points, the ulcers being punched out and secreting an abundant yellowish pus. The border of the syphilitic ulcer is not indurated as in epithelioma.

It is sometimes difficult, when a wart has been irritated, to say whether it has become epitheliomatous, but a safe rule is to treat the condition just as if it were malignant.

In the early stage of epithelioma, before ulceration has occurred, it is possible to confound it with seborrhœa. In seborrhœa the skin is not infiltrated, and the crusts are composed of dried sebum and epithelial scales, which when removed exhibit distended sebaceous follicles. The localized hypertrophy of the skin called keratosis senilis is sometimes

very difficult to distinguish from epithelioma. The principal point of difference between keratosis and epithelioma is that epithelioma is usually single, while keratosis is often found in more than one place; as keratosis senilis is not infrequently the starting-point for epithelioma, it is of the greatest importance to watch all cases of this affection with care.

Rhinoscleroma occurs most often on the upper lip, about the nares—a site very rare for epithelioma. Rhinoscleroma does not ulcerate, but this forms a comparatively early step in the evolution of epithelioma. Finally, a microscopic examination might reveal the bacilli of rhinoscleroma.

Treatment.—No internal treatment has as yet been discovered which will arrest the progress of cancer. In the later stages of the disease supporting measures, together with anodynes to relieve pain, must be used.

The curative treatment of epithelioma is wholly local. The object to be attained is the complete destruction of all cancerous tissues. That method which accomplishes this result most surely, with the least pain and inconvenience to the patient and with the minimum of subsequent deformity, is to be chosen; but it is always to be borne in mind that no considerations of a cosmetic sort can ever excuse the surgeon from making the destruction thorough. The local measures which have been advocated are removal of the growth with the knife or curette, destruction by caustics or electricity, the application of parasiticide remedies, and inoculation with specific germs which are supposed to be antagonistic to the organisms which cause cancer.

Removal by the knife has the advantages that it is exact, that it is less painful than most other methods, and that the removal can be accomplished at one operation. In regions where sufficient tissue can be spared to ensure an incision wide of the diseased area it is the ideal method. But excision has certain drawbacks. It is a matter of guesswork how far outside the apparently involved area the incision must extend, as we have no means of determining the distance to which single cancer-cells or groups of cells have penetrated into the surrounding tissues. If any of these cells are left, recurrence is very likely to occur, especially if primary union of the wound take place, for by this method of healing any advantage to be derived from the influence of inflammatory action on the remaining cancer-cells is lost. For this reason many recommend that after removal of an epithelioma the wound be cauterized and left to heal by granulation. It is a further disadvantage of the knife that by its use no selective action is exercised, but the healthy tissue inside the lines of the incision is removed along with the diseased. The resulting deformity is thus greater than by some other methods, and in certain regions, such as the nose or the eyelid, this is a matter of no small importance.

Although the curette has been strongly recommended, its use is very limited. If with the knife the removal of all the new growth is a matter of great difficulty, it may be said to be almost impossible with the curette. In the opinion of the writer the curette should be used to prepare the way for other treatment, as by removing the softer or necrotic portions of a growth, so that a caustic or other remedy may act more rapidly and thoroughly.

Caustics have long been employed in the treatment of cancerous growths. It is unfortunate that they constitute the principal means of treatment employed by charlatans, since on this account they have been somewhat neglected by physicians. A great number of chemical preparations have been used for the purpose of producing destruction by cauterization, among which may be mentioned arsenic, caustic potash, chloride of zinc, nitrate of silver, the stronger mineral acids, carbolic acid, acid nitrate of mercury, ethylate of soda, lactic acid, and pyrogallic acid. The use of a caustic agent has the advantage that the area of action is not limited to the line of application, as is the case when the knife is used. The inflammatory reaction influences the tissues to a greater or less distance around the area to which it is actually applied. While this inflammatory disturbance will not be great enough to destroy the normal cells within its sphere of influence, the cancer-cells may be destroyed, as we know that their physiological resistance is less than that of the normal cell. Thus with a properly selected caustic we can accomplish destruction of the diseased tissue with small loss of the unaffected portions. Robinson[1] believes that during the action of a caustic a toxalbumin is formed which acts in an unfavorable manner upon the cause of cancer. He supports this opinion by a reference to the decrease in size of glands at a distance from the growth which were presumably the seats of secondary infection that he has observed after the use of a caustic. Some caustic agents such as arsenic and pyrogallic acid have a selective affinity for cancerous tissue, destroying it, while the normal parts are left comparatively unaffected. The caustics which are most valuable are arsenious acid, chloride of zinc, and caustic potash.

Arsenic is used in the form of a paste made by rubbing together equal parts of acacia and arsenious acid and adding enough water to make the mass of the consistency of butter. The paste should be freshly prepared each time it is used. It should be spread on a piece of cloth large enough to extend beyond the elevated margin of the tumor. This may be held in place in contact with the tumor by means of strips of adhesive plaster. Marsden originally recommended that a space not larger than one square inch should be attacked at a time, but Robinson has applied the paste to a much larger surface and has not observed any injurious effects. Arsenic is not a suitable remedy about the lips and mucous membranes, on account of the danger of absorption. The application of the paste is usually accompanied by considerable pain. The remedy should be allowed to act continuously for from fourteen to twenty hours. If the pain is not too great and the evidences of inflammatory reaction not severe, the use of the paste should be continued the full limit of time, as it has been found that it takes arsenic longer than this to destroy the normal skin. If upon removal of the drug all the cancer mass seems to be necrosed and there is considerable inflammation extending around it, the action may be regarded as sufficient. If such a result is not secured, the caustic must be reapplied till the desired effect is obtained. The resulting wound should be dressed with a soothing salve. If it heals promptly from all sides, the treatment may be considered successful, but if at any portion the healing is slow or if unhealthy granulation spring up, the paste must be again applied to that portion.

[1] *International Journal of Surgery*, July, 1892.

Chloride of zinc may be used in the stick form, in solution, or as a paste. The use of this caustic is attended with more pain than follows the application of arsenic. In the stick form chloride of zinc is especially suitable for cauterizing epitheliomata at the inner canthus or on the lids, as its action is easily controlled. In solutions of the strength of 50 per cent. or less it is of great service in cauterizing wounds after excision of a growth. As a paste, zinc chloride is one of the most reliable agents for the destruction of epitheliomata. Bourgard's formula for the paste is:

Wheat flour,		
Starch,	*āā.*	℥j;
Acidi arseniosi,		gr. viij;
Hydrarg. sulph. rub.,		gr. xl;
Ammonii muriat.,		gr. xl;
Hydrarg. bichloridi,		gr. iv;
Zinci chloridi cryst.,		℥j;
Hot water,		℥iss.

All the ingredients except the zinc and water are finely ground together. The zinc is then dissolved in the water, and this is poured upon the powder, stirring all the time. The paste after standing twenty-four hours is ready for use.

The paste is to be spread on cotton or linen cloth and applied to the epithelioma for twenty-four hours. If all the growth does not seem to be destroyed at the end of this time, the paste is to be reapplied. On account of the severe pain caused by the chloride of zinc it is well to add cocaine to the paste. The treatment of the resulting wound is the same as after the use of arsenic.

Caustic potash in the stick form is the caustic most highly prized by many authors. The advantage of the remedy is that it acts rapidly, so that considerable destruction is quickly produced. Its application is quite painful. Caustic potash has no selective action, destroying both normal and diseased tissues with equal facility. When it is important to save tissue, it should not be used. On account of the difficulty of limiting the action of this caustic it should not be employed about the eye or in the vicinity of large vessels or other important structures.

Pyrogallic acid has had many warm advocates. Its action is slow and painless. It may be used in the form of an ointment:

Acidi pyrogallici,	ʒij;
Emplast. plumbi,	℥j;
Cerati resinæ co.,	ʒv.

This is spread on cloth and kept constantly applied for from a day to a week according to the destruction necessary. The acid has a selective action, attacking very little the healthy tissues. It is a good remedy with which to follow the use of the curette.

The remedies mentioned constitute the most valuable of the caustics. Most of the others are not sufficiently destructive in their action, and are dangerous because they often serve rather as a stimulant than as caustic agents.

Electricity may be used in the treatment of epithelioma, either as the galvano-cautery or as the electrolytic needle. The galvano-cautery destroys the part to which it is applied, and has no advantages over the knife except that there is a slight amount of inflammatory reaction following its use, and that the operation is bloodless. The electrolytic needle affords a valuable method of treatment when a small epithelioma is to be destroyed, especially about the eyelid or other part where the destructive method used must be wholly within the control of the operator. The apparatus used is that described under Nævus Vascularis. A rather stout needle is used, and this is thrust under the infiltrated base of the tumor, entering in healthy skin on one side and coming out through healthy skin on the other. The needle is thus passed from all sides till a complete destruction of the growth is secured. The necrosed mass may be left to separate by itself, or it may be at once scraped away and a solution of chloride of zinc applied to the wound. After the wound has had time to get rid of the slough it should be carefully inspected, and if any suspicious portions are seen these must be destroyed. It has seemed to the writer that the action of electrolysis is not confined to the tissues actually destroyed, but extends to parts apparently not injured, causing here perhaps the death of the specific cells, which are more readily injured than their normal neighbors.

Of the remedies which have been used in the treatment of epithelioma with a parasiticidal intent, methylene blue has recently attained the best reputation. In $\frac{1}{2}$ per cent. solution in the daily dose of one gramme it has been injected into the tumor, while at the same time the ulcerated surface has been dressed with compresses wet with a 1 per cent. solution of the drug. Darier[1] recommends the use of methylene blue in the following manner: The ulcerated surface is first freed from crusts, and the hard, thick border of the ulcer is lightly touched with the galvano-cautery to promote the absorption of the drug. To the surface thus prepared a 10 per cent. solution of methylene blue in equal parts of glycerin and alcohol is applied, and immediately afterward a 20 per cent. solution of chromic acid. The blue is then again applied and the epithelioma dressed with sublimate gauze. Four or five such applications are made at intervals of two or three days, and then the blue alone is used till the new-formed skin no longer takes the blue color. It is claimed that by this method superficial epithelioma can be healed in from three weeks to two months. While methylene blue is being locally applied it may also be administered in the daily dose of $\frac{3}{10}$ gr.[2]

Many observations have been from time to time recorded which show that cancerous tumors are not infrequently benefited or even cured by an intercurrent attack of erysipelas. Fehleisen in 1883 made use of this fact by artificially inoculating certain inoperable cases of malignant tumors with the germs of erysipelas. Coley has recently collected a number of cases of carcinomata in which erysipelas occurred either accidentally or after intentional inoculation, with cure in a few cases and benefit in others. The toxic products of the growth of the germs have also been used, but the results have not as yet been so good as where the disease was actually inoculated. As long as erysipelas is the severe and

[1] *La Semaine médicale*, June 10, 1893.
[2] *American Journal of Medical Sciences*, May, 1893.

uncontrollable affection it now is, it is not probable that it will often be inoculated for the cure of epitheliomata unless the disease has been neglected in its earlier stages. On the other hand, if it were shown that the toxic products could be used with certainty this would form a very valuable means of treatment.

No attempt has been made to mention all the methods of treatment which have at various times been used in epithelioma: only those have been selected which now give promise of utility. Those who believe in the parasitic origin of cancer live in hope that a remedy will be discovered which will be capable of destroying the organisms in the body of the patient without injury to the host. In the mean time it cannot be too strongly insisted upon that the only safety of the person suffering from epithelioma consists in the complete destruction of the growth at the earliest possible moment.

Prognosis.—The course of the deeper form of epithelioma is often rapid, killing the patient in the course of a few months. The superficial form may take years to effect any noticeable destruction of tissue, but unless its ravages can be stayed its course is one of steady progress.

PAGET'S DISEASE OF THE NIPPLE.

Paget's disease of the nipple has also been called malignant papillary dermatitis, on account of its tendency to eventuate in carcinoma. The disease almost always commences on the nipple, though a case has been reported affecting the scrotum. Women in the middle period of life or beyond are the common victims of the malady. As usually seen by the surgeon, the nipple and areola present a red, raw, granular surface, as though the epidermis had been completely removed. The edge of the affected area is sharply defined and abrupt, and if the disease has persisted for some time there is marked infiltration of the involved tissues. From the surface there is constantly exuding a clear viscid matter. In many of the original cases reported by Paget cancer of the breast occurred in two or three years, but in other cases the malady has run a course of ten to twenty years. The subjective symptoms are tingling and burning.

Etiology.—It has always been a matter of dispute whether the disease is from the beginning cancerous in nature, or whether the malignancy is a secondary phenomenon consequent upon the constant irritation. The cases which Thin examined all showed a cancerous nature, but the cases were not in the earliest stages. Darier and others have found bodies which they think are psorosperms.

Anatomy.—In the affected area, though the upper layers of the epidermis are wanting, there is an increased development of the interpapillary processes, often causing an obliteration of the papillæ. Scattered through the growth are collections of epithelial cells like cancer-nests. The first malignant change in the breast seems to occur in the lactiferous ducts. The bodies which are thought to be psorosperms may be demonstrated by scraping the diseased surface and soaking the scrapings in liquor potassæ. The bodies are oval or round with a nucleus and a double-contoured cell-membrane.

Diagnosis.—Paget's disease is most likely to be confounded with

eczema of the nipple. Eczema is most common during the childbearing period, while Paget's disease occurs later in life. In eczema there is much less induration, and while the surface is fissured and crusted there is not that degree of rawness seen in Paget's disease. In Paget's disease the border is sharply defined, but in eczema it fades more gradually into the surrounding tissues. Paget's disease is generally unilateral. In time retraction of the nipple occurs, with the development in the breast of hard nodules.

Treatment.—In the earlier stages, as it is often extremely difficult to determine the true nature of Paget's disease, the affected region should be treated with soothing salves, such as would be used in eczema. Under no circumstances should irritants or mild caustics be used, since they simply aggravate the condition. As soon as the true nature of the malady is made out the breast should be entirely removed.

Prognosis.—The disease may exist many years without determining any deterioration of the general health, but unless removed it will ultimately prove fatal. If the breast is early removed, the prognosis is more favorable.

SARCOMA CUTIS.

In most instances sarcoma of the skin is secondary to a similar growth of some other organ. Not infrequently, however, the disease occurs primarily in the skin. Clinically, sarcomata of the skin may be divided into the non-pigmented and the pigmented form.

Non-pigmented sarcoma may exist as a single growth or large numbers of tumors may be present. In some cases the first tumor springs from a mole or scar which has been irritated. About this other tumors develop till a whole part or extremity is thickly studded with them. The individual growths vary in size from a pea to a pigeon's egg or larger, are smoothly round or lobulated, and usually firm to the touch. The skin over the lesion is, at least in the earlier stages, normal in color, but as the malady progresses it assumes a livid or reddish hue. In the course of time the skin lying between the growths becomes swollen, red, and infiltrated. A limb may thus come to resemble a member affected with elephantiasis. In a few months the nodules coalesce, break down and ulcerate. The clinical history and appearance of this form of the disease will vary much according to the number of tumors and their anatomical constitution.

The course is usually toward a rapidly fatal issue.

Of the pigmented sarcomata there are several varieties. Most commonly a pigmented nævus or other pigment deposit will be noticed to grow rapidly till a tumor is formed. The growth is generally soft, but may be quite firm. The amount of pigment may be so great as to give to the tumor an inky blackness. The growth may remain single, involving new tissues by peripheral extension, but more often around the primary deposit small dark spots develop which mark the starting-points of new centres of invasion. Often secondary growths occur at long distances from the original tumor, the infection being carried by way of the lymphatics or blood-vessels. After the tumors have attained some size they ulcerate, fungate, and bleed easily. This form of sarcoma is nearly always rapidly fatal.

PLATE V.

AUTHOR'S CASE OF ALVEOLAR SARCOMA OF THE SKIN.

Under the name "idiopathic multiple pigmented sarcoma" Kaposi has described a peculiar form of sarcoma of the skin. The first lesions of this sarcoma may occur on the palmar or plantar surfaces of the hands and feet as pea- to hazelnut-sized, roundish tumors of a red-brown or plum color. The nodules may be discrete or arranged in groups. Other portions of the extremities are gradually involved, and in the course of two or three years the lesions appear upon the face and trunk. The skin between the tumors becomes infiltrated, of a reddish color, and as hard as a board, so that an extremity may become useless. After a long time the mucous membranes become involved. The tumors upon the skin do not ulcerate, but may undergo involution, leaving pigmented scars, but the lesions of the mucous membranes soon break down, and this ushers in the fatal termination. This form of sarcoma most often attacks those in middle life. It runs a course of from three to twelve years. (Plate V.)

Under the title of "melanotic whitlow" Hutchinson has described a pigmented sarcoma which commences as a bluish stain at the free border of the skin about the nail. This develops into a fungating, pigment-containing growth, and finally becomes generalized.

Etiology.—The etiology of sarcoma is unknown.

Anatomy.—Sarcomata are all built up more or less on the plan of embryonal tissue. The growth consists of cells and a connective-tissue stroma mingled in varying proportions. No tumor presents so many variations in its anatomical arrangement as sarcoma, and for this reason the microscopical diagnosis may be very difficult. The cells which make up the mass of the tumor may be round, spindle-shaped, or branching, with one or sometimes several nuclei, with or without pigment-granules. The connective-tissue stroma may be so delicate as to escape notice, or so dense as to suggest that the growth is a fibroma. In the idiopathic multiple pigmented sarcoma the pigment is due to hemorrhages into the skin, and Perrin has contended that this form of the disease should be classed among the non-pigmented sarcomata. Recently Kaposi[1] has suggested that the more fitting name would be "sarcoma idiopathicum multiplex hæmorrhagicum."

Diagnosis.—The non-pigmented forms of sarcoma might in their early stages be mistaken for fibromata. Idiopathic multiple pigmented sarcoma is most apt at first to be confounded with plantar or palmar syphilis and, at a later period, with mycosis fungoides or leprosy. The surest way of settling the diagnosis is by a microscopical examination.

Treatment.—When only single tumors exist removal by the knife should be attempted, but it is a lamentable fact that recurrence is very likely. In the generalized forms of sarcoma a method of treatment which has given some success is that introduced by Köbner. This consists in the subcutaneous injection of Fowler's solution diluted with water. The dose used has been from two to six minims once a day.

It has been known for a long time that after an accidental attack of erysipelas malignant tumors would sometimes improve or even recover. Various experimenters have made use of this fact by producing artificial erysipelas by inoculation. Quite recently Coley[2] has reported some very

[1] *The Medical Week*, April 20, 1894.

[2] Coley, *The American Journal of the Medical Sciences*, July, 1894.

encouraging results from the subcutaneous administration of the combined toxines of the micro-organisms of erysipelas and the bacillus prodigiosus. As yet, the experiments are too few to permit of drawing any definite conclusions, but in view of the utter hopelessness of many cases of sarcoma the surgeon should avail himself of every means which offers any chance of success.

Prognosis.—In all forms of sarcoma of the skin the prognosis is very serious, from the tendency to recurrence after removal. In proportion to the generalization of the disease the prognosis becomes worse, but at least one spontaneous recovery in a case of idiopathic multiple pigmented sarcoma has been recorded.[1]

Parasitic Affections.

MADURA FOOT.

Podelcoma, or Madura foot, is a disease found principally in India, though a case has been reported in this country. There are two varieties of the malady, which are known as the black and the white, the only difference being the presence or absence of certain black bodies to be mentioned. The disease attacks generally the foot, though the hand and scrotum may be affected. The first evidence of the affection is a vesicle, pustule, papule, hard nodule, or a black mottling of the skin like tattoo-marks. After a time a sinus forms which discharges pus, whitish bodies, and then black masses resembling fish-roe. In a fully-developed case the foot is much distorted, the arch broken down, the whole foot studded with nodules representing the orifices of sinuses. About the sinuses are scattered black granules in the skin. The discharge of the black roe-like masses from the sinuses is the most characteristic sign of the disease, though it is absent in the white variety of podelcoma. These masses contain a ray fungus very similar to actinomycosis fungus.

Madura foot runs a very chronic course, but is not dangerous to life. When an affected foot is examined by dissection, the sinuses are found to lead into cavities containing both the white masses which are found in the discharge and the fish-roe-like bodies.

Complete removal of the diseased tissue seems to be the only successful treatment. When the disease is superficial scraping with the sharp spoon may accomplish this. If only a toe or a finger is involved, it should be amputated. If the disease is advanced, only the removal of the limb well above the affected area will suffice.

ACTINOMYCOSIS.

Actinomycosis of the skin is a very rare affection. It usually develops as secondary to a deposit of actinomyces in the deeper tissues. In this form the disease is most common in the neck and about the lower jaw. Over an indolent hard swelling the skin becomes thinned, red, and eventually gives way, discharging pus which may contain the characteristic yellow, pinhead-sized granules. In this form the disease very much resembles what is seen in tuberculous glands. When a sinus

[1] Hardaway, *Journal of Cutaneous and Genito-urinary Diseases*, p. 21, 1890.

has thus formed at times about the opening, nodules of a reddish or bluish hue form, which may suppurate. Another form in which actinomycosis of the skin occurs is a dense induration of the skin and subcutaneous tissue with several sinuses, somewhat resembling carbuncle.

Actinomycosis generally arises by the fungus gaining access to the body through a carious tooth, and this explains why it is so commonly seen about the neck and jaw. It has been observed to attack other parts of the body, as the hands, and many regard Madura foot as a form of actinomycosis.

The **cause** of the disease is the ray fungus, which is most apt to be discovered if the granules mentioned above are subjected to a microscopical examination. The fungus is seen as small threads branching from a common centre and expanding at the peripheral extremity into club-shaped masses. When examined by a high power these threads are found to be made up of little spherical bodies arranged in rows and held together by a delicate membrane. The club-shaped bodies are thought in reality to be degeneration forms.

Actinomycosis is usually acquired from animals, but it is possible that it may be got by handling straw or grain. The disease may have an incubation period of months or years.

The only way to make a positive **diagnosis** of actinomycosis is to find the fungus, and this is often difficult.

Treatment.—It was formerly thought that the prognosis in actinomycosis was invariably bad. On this account the most serious operations were readily undertaken. More recent observations have shown that a large proportion of the cases live many years, and some recover spontaneously, so that severe operations are looked upon with disfavor. When possible, sinuses and abscesses should be thoroughly laid open, and, after curetting, washed with a solution of bichloride of mercury. Gautier cured a case by liberating nascent iodine in the tissues by means of injecting solutions of iodide of potassium, and then passing a galvanic current by needles introduced into the tissues. For some time veterinarians have attributed value to the use of iodide of potash in cattle, and recent reports[1] of the use of this drug in man are so favorable as to make it the duty of the surgeon to try the remedy thoroughly in every case.

[1] Ransom, *British Medical Journal*, Jan. 27, 1894.

SURGERY OF THE GENITO-URINARY SYSTEM.

By J. WILLIAM WHITE, M. D.,

ASSISTED BY

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Surgical Diseases of the Kidneys.

Surgical Anatomy.—The kidneys are situated in the hypochondriac region on either side of the vertebral column, behind the peritoneum. The right kidney extends from the level of the tip of the twelfth rib to the level of the spine of the third lumbar vertebra, and, being somewhat depressed by the large right lobe of the liver, it is slightly lower than the left kidney. The left kidney extends from the interval between the outer third of the eleventh rib and the tip of the twelfth to the level of the interspace between the spines of the second and third lumbar vertebræ. Both rest not only upon the lower part of the arch of the diaphragm, where it descends in front of the twelfth rib, but also below the twelfth rib, upon the quadratus lumborum muscle, although separated from it by the layer of loose areolar tissue which surrounds them, as well as by the anterior layer of the lumbar fascia; and, finally, they rest upon the psoas muscle, hence the slight depression upon the posterior surface of each kidney.

The upper extremities of the kidneys are partially covered by the peritoneum anteriorly, and the anterior surface of the right kidney is in contact with the duodenum and transverse colon, while the descending colon lies against the anterior surface of the left kidney. The right kidney is in contact also with the under surface of the liver, and the left kidney at its upper extremity lies against the fundus of the stomach, and at its lower extremity touches the pancreas; on the upper two-thirds of its external border it touches the spleen.

A kidney of average size measures four and a half inches in length, two and a half inches in breadth, and an inch and a quarter in thickness, and weighs about four and a half ounces. It is irregularly oval in shape, with a convex outer border and a concave inner border. The convex borders of the kidneys correspond to the outer edge of the quadratus lumborum and erector spinæ muscles, or, in other words, a vertical line about four inches from the spines of the vertebræ would about indicate the location of these borders.

The concave borders on which are the hiluses of the kidneys, whence the blood-vessels have their exits and entrances and the ureters are given off, are on a level with the first and second lumbar spines and about two

inches from the median line of the back. The renal arteries and veins will be, therefore, found on a level opposite the space between the spines of the first and second lumbar vertebræ, and, seen from behind, are crossed by the dilated portion of the ureter—known as the renal pelvis—as it leaves the hilus of the kidney. The ureters vary in length from fourteen and a half inches to sixteen, and are about three-sixteenths of an inch in diameter; they extend downward, gradually converging, and pass into the pelvis near the sacro-iliac synchondrosis. Within the pelvis they follow the curve of the pelvic wall close to the border of the sacrum, and pass into the posterior false ligament of the bladder beneath the obliterated hypogastric artery, and then enter the bladder at its base, passing obliquely between its muscular and mucous coats for nearly an inch; then, about an inch and a half apart, they open into the cavity, in the male about an inch and a half behind the base of the prostate at the two posterior angles of the vesical trigone. In their course to the pelvis they lie upon the psoas muscle, with the right ureter close to the outer side of the inferior vena cava. In the male the vas deferens lies between the ureter and the bladder; in females the ureters pass along the sides of the cervix uteri and the upper part of the vagina. The kidneys are held in place by their vessels and excretory duct, and also by the mass of areolar and adipose tissue in which they are imbedded.

The hilus extends to a considerable distance within the substance of the kidney, and forms a cavity known as the sinus; this is lined by a prolongation of the fibrous capsule. The solid part of the organ is composed of a cortical and a medullary layer: the cortical layer forms the superficial part of the organ, and contains the Malpighian glomeruli, which are the beginnings of the uriniferous tubules. The medullary layer contains the straight and spiral portions of the uriniferous tubules, as well as the collecting tubules. The tubules are arranged in separate pyramidal masses, the so-called "pyramids of Malpighi," whereof the apices form the papillæ projecting into the pelvis. They are separated from each other by the cortical substance, which envelops them on all sides except at the papillæ.

The papillæ project into the calyces or infundibulæ, which are the small divisions into which the renal pelvis subdivides after merging into the sinus; at their apices are the openings of the uriniferous tubules, whence the urine issues and is collected in the calyces or infundibulæ, which in turn open into the pelvis.

The arteries of the kidneys divide into four or five branches and enter at the hilus, where they lie between the renal vein and the ureter. Within the sinus the branches of the artery lie alongside the infundibulæ, and are imbedded in a layer of fat. The right renal artery is slightly longer than the left; it has to cross over the vertebral column. For a similar reason the left renal vein is longer than the right. The renal veins leave the kidneys at the hilus, and, passing in front of the renal arteries, empty into the vena cava. Small branches of the veins from the suprarenal bodies and the left spermatic vein join the renal vein on the left side. The upper extremities of both kidneys are capped by the suprarenal bodies.

Anomalies of the kidneys are found in their size, their shape, their position, and in their attachment; of these, anomalies in size, in shape,

as well as in attachment, may be not only congenital, but acquired. Abnormal positions which do not come within the class of movable or floating kidneys are congenital.

Congenital *enlargement* of one kidney is frequently found; it is, however, usually associated with atrophy, or possibly with the absence of the other kidney, whereby the working kidney becomes enlarged by being forced to do double duty.

Congenital *absence* of one kidney has been noted sufficiently often to warn the surgeon before performing nephrectomy to make sure of the presence of two kidneys. It may be worth while to note, more as a matter of curiosity than of surgical importance, that instances have been recorded of children born lacking both kidneys; of course life could be maintained but for a few hours or days.

Variations in *shape* are due in some cases to the size or to malformation of neighboring organs or bony structures, where the malformation has been caused either by mechanical injury or by disease; in other cases they are congenital, where, for instance, either the lower or the upper extremities of the kidneys may be connected together and bridge over the abdominal aorta and inferior vena cava, as has been noted in rare cases; this connection may consist of true kidney-structure or may be merely a band of connective tissue, whereby the organ assumes a horseshoe shape. Again, this connection may in still rarer cases extend along the whole inner border of the kidneys, and thus form one large oval or roundish organ, with the blood-vessels and excretory duct attached to its centre or possibly to one side. Woolsey[1] gives the ratio of the frequency of horseshoe-shaped kidneys as 1 in 1600; of single fused kidneys as 1 in 8000; and of the entire absence of one kidney 1 in 4000.

The comparative frequency of the horseshoe shape should suggest caution in all operations on the kidney; any attempt at nephrectomy in such cases would undoubtedly prove disastrous. A union merely ligamentous or of connective tissue would not, however, preclude a separation of the organs.

The kidneys may be also found extremely lobulated, so as almost to resemble a bunch of grapes; this anomaly is the result of arrested development. In the fœtus lobulation of the kidneys is normal and noticeable. Three distinct and separate kidneys have been also found. Kidneys possessed of two pelvises and two separate ureters, one above the other, have been recorded.[2] The main bodies of the kidneys were, however, perfectly normal.

Anomalous positions of the kidneys occur in rare instances. Both kidneys may be situated on the same side of the spinal column, or one or both may be displaced downward and found in the cavity of the pelvis.

Anomalies of Attachment.—The terms "floating kidney" and "movable kidney" are almost universally used as synonymous, but the distinction between them lies in the fact that the "floating kidney" is always a congenital anomaly in the attachment of the organ, while a "movable kidney" is the result of external injury or internal strain. The true floating kidney is a rare anomaly, where the kidney is attached to the abdominal wall by a reduplication of peritoneum—a mesonephron—and

[1] *Morrow's System of Genito-urinary Diseases*, p. 11.
[2] Morestin, *Bull. de la Soc. anat. de Paris*, Oct., 1894.

lies within the peritoneal cavity. An acquired movable kidney is retroperitoneal, and is freely movable either outside of its fatty capsule or entirely within it. It is due to a stretching and lengthening of the normal attachments between the peritoneum and the perinephric fat. The same amount of motion is common to both cases. Whether or not a congenital floating kidney can be successfully cured by the operation usually employed for the relief of movable kidney is yet to be proved; the operation is quite new to surgery, and extremely few cases of true floating kidney have been recognized before death. Since the above was written two cases of true floating kidney have been reported by W. Bruce Clarke. The operation of nephrorrhaphy entirely cured the painful symptoms in one case, but in the other the pain persisted and nephrectomy was subsequently performed. At the second operation the kidney was found to be firmly fixed to the abdominal wall in proper position. In both cases the sutures were passed through the peritoneal coats only.[1]

Movable kidney has for its most frequent causes pregnancy and the subsequent relaxation of the abdominal walls, injury in the lumbar region, and strains from lifting heavy weights. Too much importance has perhaps been given to pregnancy in the etiology of movable kidney, inasmuch as a large proportion of the cases occur in young girls. Landau[2] gives, as the chief cause, the disappearance of fat from the fatty capsule, a result of disease usually acute in character. This has been our experience. The proportion of cases in women to those in men is about 7 to 1.[3] It occurs on the right side with far greater frequency than on the left.

The **symptoms** of movable kidney are pain in the lumbar region, sometimes amounting to only slight uneasiness and at times to excruciating paroxysms, due, probably, to the twisting or the compression of the vessels and of the nerves. These symptoms are decidedly ameliorated by change of position, and rarely, if ever, come on when the patient is at rest. The pain in paroxysms appears exceedingly like an attack of renal colic due to the passage of a calculus through the ureter, and is often accompanied by nausea and vomiting.

Bruce Clarke,[4] under the title "Acute Renal Dislocations," has well summarized the symptoms of the most severe forms of these attacks. They usually begin without warning: "The patient is seized with an acute pain in one or other of his kidneys. Like most pain of renal origin, it is very liable to radiate down the thigh and into the groin, or may be referred to some portion of the lower part of the abdomen. In an hour or two the region of the affected kidney both in front and behind becomes acutely tender, and a local distention of the intestines often ensues. More rarely this distention spreads to the whole abdomen, often giving rise to a suspicion of peritonitis, and seeming to point for a while possibly to a sudden perforation of the intestine. But the difficulty of diagnosis, if it exists at all, soon clears up. If an examination of the abdomen can be obtained within an hour or an hour and a half after the onset of the symptoms, and before the distention of the intestines has taken place, much difficulty is not usually experienced in arriving at a

[1] *Brit. Med. Journ.*, Mar. 16, 1895. [2] *Die Wanderniere der Frauen*, Berlin, 1881.
[3] Newman, *Surg. Dis. of Kidneys*; and Landau, *Arch. f. klin. Chir.*, 1879.
[4] *The Medico-Chirurgical Transactions*, London, vol. lxxvi.

correct interpretation of the symptoms. Some enlargement of the kidney can generally be detected, and pressure on the tumor gives rise to a peculiar sensation of nausea, occasionally passing on to actual vomiting, and often accompanied by faintness. But before long a period of obscurity supervenes; the abdomen, which was lax and painless, grows tumid, flatulent, and agonizing when handled, and at times a cold sweat stands on the brow of the sufferer. This condition, in which pain is the prominent symptom, may remain almost unchanged for several days, but it usually begins to subside after some hours, and after a few days the kidney regains its abnormal mobility, of which perhaps the attack in question has afforded the first indication either to the patient or his medical attendant. The condition of the urine during these attacks is subject to considerable variation, dependent probably upon the extent to which the blood-supply is interfered with. It may be scanty and blood-stained or almost porter-colored and smoky, and bearing a marked resemblance to the urine of acute Bright's disease. When it occurs, one of the first and most reliable symptoms of the abatement of the attack is the passage of a considerable amount of clear, pale urine of a very low specific gravity (so-called *hysterical urine*). Occasionally these attacks are accompanied by marked pyrexia and general constitutional disturbance, and when this is the case there is some difficulty in distinguishing them from more grave and serious affections."

Drummond[1] has noticed a remarkable frequency of symptoms of intestinal catarrh associated with movable kidney.

Müller[2] long ago called attention to the association of dyspepsia and dilatation of the stomach with movable right kidney. The cases were observed mostly in young girls who laced tightly and performed severe work. Bartel[3] gives the following explanation: "The kidney is pushed forward and inward, pressing on the pars descendens duodena, which cannot move owing to lack of mesentery; consequently easy emptying of the stomach is hindered, the muscular layer is strained and finally becomes lax. The stomach becomes dilated, and severe chronic gastritis is set up." Edebohls claims that many of these symptoms are produced by tension upon the filaments of the great sympathetic centre (the solar plexus).[4] This view depends on the circumstance that many of the same symptoms are said to occur in cases of movable left kidney, when they cannot, of course, be due to duodenal obstruction. The paroxysms of pain in cases of movable kidney are rarely, almost never, followed by hæmaturia, as is the case in renal colic, unless the displacement has occurred suddenly and violently; unlike renal colic, the pain is much less severe when the patient is in a recumbent position or with the hips raised, so as to allow the kidney to fall back into its proper position. In addition to this, a movable, kidney-shaped tumor is in most cases to be plainly detected in the hypochondriac region. Jaundice due to pressure on the gall-duct by a movable right kidney has been observed in some cases.[5]

Mr. Henry Morris[6] has called attention to the following facts: (1)

[1] *Lancet*, Jan. 11, 1890. [2] *Wien. med. Wochenschrift*, 1879, xxix. 73–76, 108–110.
[3] Quoted by M. H. Richardson, *Boston Med. and Surg. Journ.*, June 14, 1888.
[4] *Am. Journ. of the Med. Sciences*, March, 1893.
[5] W. H. White, *Brit. Med. Journ.*, Jan. 30, 1892. [6] *Brit. Med. Journ.*, Feb. 2, 1895.

That movable kidney and enlarged gall-bladder are each much more frequently met with in women than in men; (2) that the right kidney is many times more frequently movable than the left; and (3) that movable kidney and enlarged gall-bladder often occur in the same person. He believes that the association of the two states in the same person is explained by the custom of wearing corsets, and thinks, too, whereas the downward pressure of the liver induces mobility of the kidney, the mobility of the kidney in turn reacts upon the gall-bladder and causes distention by dragging upon the duodenum and the bile-ducts, and thus obstructing the passage of the bile. "In this way we can understand how it is that women are frequently the subjects at once of distended gall-bladder and movable right kidney. That only a few women who tight-lace get either an enlarged gall-bladder or a movable kidney does not invalidate the argument, because the shape of the thorax of some, the amount of fat in others, and the natural strength of the visceral conditions in others may frustrate the injurious effects of lacing." The symptoms which are common to the two conditions are several, and are summarized by Morris as follows: "Both enlarged gall-bladder and movable kidney may present as a tumor in the right hypochondriac and umbilical regions. Either tumor may be capable of being pushed back into the loin or over to the left of the median line. In both cases the tumor is more or less firm or elastic and smooth. In both cases it may be either very tender or not at all so. In either case it may be or seem to be round or oval, or shaped like an egg, a pear, or an orange, or a sausage." Morris has known each to present "a smooth, firm, and rounded projection on its surface, in the case of a kidney due to a cyst beneath the front of the capsule, in the gall-bladder to a calculus in a pouch in its anterior wall. Both may have either a resonant or a dull note on percussion in front. Both give rise to various dyspeptic symptoms—nausea, sickness, flatulence, pain after eating, and constipation. Either may give rise to paroxysmal attacks of severe colic, the maximum intensity of which is referred to the situation below the ribs on the right side of the abdomen. In enlarged gall-bladder these attacks are due to the sudden impaction of a gall-stone in the cystic duct; in movable kidney, to kinking or rotation of the ureter or renal vessels. Either may give rise to jaundice, gastric and intestinal catarrh, or even peritonitis, though neither does so in the usual run of cases. With either there may be considerable displacement of the colon and small intestine, or adhesions; and matting together of the intestines and omentum in front of the tumor may occur. In neither case does the condition of the urine often help us, and sometimes it actually misleads, as there may be albumin in the case of distention of the gall-bladder or bile in the case of movable kidney." The diagnosis between these two conditions is obviously not an easy one. Mistakes will be lessened by (1) remembering that an enlarged gall-bladder may be a *movable* abdominal tumor; (2) inquiring as to a previous distinct attack of jaundice; (3) giving due weight to the existence of an easily palpated tumor. An enlarged gall-bladder can almost always be felt, a movable kidney (unless also enlarged) cannot. (4) Variations in the size of the tumor, followed by a marked increase in the urine voided,

indicate movable kidney with temporary vascular turgescence or hydronephrosis; (5) a gall-bladder with many calculi feels harder than a movable kidney; (6) a kidney has a much wider range of movement; a gall-bladder moves only in the arc of a circle the centre of which is a point beneath the edge of the right lobe of the liver; (7) if the two conditions coexist, "it is generally possible to grasp the kidney, or at any rate its lower extremity, between the two hands by pushing the tumor forward and toward the median line with the back of the finger-tips of the right hand, and at the same time pressing forward the loin with the fingers of the left hand. In this way the two organs are separately distinguished at the same moment. The kidney may be thus found to move independently of the tumor formed by the gall-bladder. This can often best be accomplished with the patient lying on the left side."

I agree entirely with Mr. Morris in the statement that too much stress is apt to be laid upon an undue hollowness and resonance with diminished resistance in the loin. These are, as he says, "unreliable symptoms—(1) Because in some positions of the trunk and thighs there is much hollowness in the ilio-costal space when the kidney is in its proper place; (2) the mass of muscle and fat in this region often prevents a tympanitic note being elicited when the kidney is displaced; and (3) the natural position of the kidney is so much under cover of the lower part of the thorax that hollowness of the loin and resistance in the ilio-costal space have no bearing upon it naturally." The relation of the colon to the tumor is equally unreliable.

Malignant disease of the colon frequently causes widespread suppuration of the loin, and has been mistaken[1] for movable kidney complicated with perinephritic abscess. In a case which I saw with Dr. William Pepper not one symptom of calculous pyonephrosis was lacking except the demonstrable presence of stone. The operation revealed a colloid cancer of the ascending colon, involving by contiguity the capsule of the kidney. Before operation the combination of urinary and intestinal phenomena was thought to be due to a possible adhesion between the wall of the gut and the kidney, with incomplete drainage of the latter by that route.

Aspiration as a method of diagnosis is dangerous, except in the presence of undoubted parietal adhesions, and is often misleading, as the fluid withdrawn is frequently not distinctive of either affection. An exploratory incision is much to be preferred.

Tumors of the omentum or mesentery may be mistaken for floating kidney, or *vice versâ;* the subjective sensations of the patient when the tumor is manipulated are, however, important guides in cases of doubt. Pressure on movable kidney causes a pain which is sickening and almost produces vomiting.

Treatment.—When the symptoms are not excessive in aged or much debilitated patients, and only slight pain follows over-exertion or undue motion, radical surgical measures are hardly indicated. Recurrence of the distressing displacement in such cases often can be prevented by avoiding unusual activity and by wearing a truss so padded that the kidney is kept from becoming dislodged. In the majority of cases, however, the physical comfort which depends upon the proper adjust-

[1] Morris, *The Lancet*, Apr. 27, 1895.

ment of steel springs or rubber pads is not all that the heart desires, and it is far better to submit the patient to the short discomfort of the comparatively simple and safe operation of stitching the kidney to the posterior abdominal wall—the operation of nephrorrhaphy.

Nephrorrhaphy, or *Nephropexy*.—This operation was first performed in 1881 by Hahn, who gave to it the name of nephrorrhaphy; it has been lately suggested to re-name the operation nephropexy, the termination being derived from the Greek πήγνυμι, to attach. The patient is placed face downward upon the operating table, and the ilio-costal region made prominent by placing a pad under the abdomen. The incision through the abdominal walls must be made about half an inch below the lower border of the twelfth rib and parallel to it, and should be of ample length to allow comparatively free manipulation of the kidney. When the retroperitoneal space has been opened the kidney, if freely movable, must be brought into view by bimanual manipulation. There is always a slight risk of wounding the liver if it has been pushed too far downward by the pad placed under the abdomen, and the operator should observe carefully the color and consistence of the organ which comes into view before passing the stitches through it.

If the kidney cannot be kept in position by simple pressure while the stitches are being passed, it may be pulled in place with a tenaculum or with volsella forceps during the operation, without serious risk from the slight laceration. The stitches which are to hold the kidney in place are then passed by means of a curved needle through the fibrous capsule of the kidney, and should also penetrate slightly the kidney substance proper from the anterior to the posterior surface just at the external or convex border. The sutures should be of strong silk or silkworm gut, about three or four in number and at half-inch intervals. Making sure that both ends of the kidney are fixed, so that there shall be no danger of subsequent rotation of the kidney on its long axis, the stitches are then made fast to the lumbar fascia, and the wound closed by means of buried catgut sutures and superficially with silk sutures. The necessity for drainage depends upon the amount of injury which has been inflicted upon the perinephric fat. In some cases the open treatment of the wound is advisable, simply protecting it with antiseptic gauze and bandage.

When Hahn first performed the operation the sutures were passed only through the fatty capsule of the kidney. It was found, however, that this method did not fix the kidney securely enough, although at the same time it was maintained that it allowed the kidney the slight normal amount of movement which was necessary when it was pressed down upon during deep inspiration. Hahn next tried passing the sutures through both the fatty and the fibrous capsule, and in 27 collected cases there were 15 cures, 4 cases were improved, 7 cases were failures, and death resulted in 1. Finally, the stitches were passed so as to include a portion of the parenchyma of the kidney. This method has been found in 59 cases to have accomplished 39 cures, 11 cases of improvement in the symptoms, 8 failures, and 1 death. It has been suggested by Guyon to ensure fixation still further, that the portion of the kidney which is included between the two ends of the suture be stripped of its capsule.

so that firm adhesions will arise between the kidney itself and the abdominal wall at the edges of the wound.

After the operation a supporting bandage should be worn for several months, and for at least a year the patient must avoid all active exercise or straining.

Although it cannot be said that good results invariably follow this operation, nevertheless, the mortality is extremely low and the chances of success are great.

The latest statistics in regard to the operation of nephrorrhaphy for movable kidney have been collected by Delvoie.[1] He has brought together 363 cases, of which he has retained only 215 as fully satisfactory in regard to completeness of report and length of time after operation. In these 215 there are 135 cured, 30 improved, 25 unimproved, 20 relapses, 5 deaths. He further divides them as follows, according to the particular form of nephrorrhaphy which was adopted:

	Cures.	Improved.	Unsuccessful.	Relapse.	Death.
Suture of the fatty capsule	4	3	2	5	0
Suture of the fibrous capsule	10	3	4	5	2
Suture of the parenchyma without stripping of the capsule	75	14	11	8	2
Suture of the parenchyma after stripping the capsule	9	0	1	0	0
Special methods	5	5	0	0	0
Operative procedures of uncertain character	32	5	7	2	1
	135	30	25	20	5
Laparotomies	2				

Nephrectomy is now considered a justifiable operation for movable kidney only when it is impossible to force the kidney back into the proper position and when the symptoms are very severe, and also when nephrorrhaphy has been tried twice and failed. Newman[2] gives the mortality following nephrectomy as about 30 per cent. Bruce Clarke has recently reported a series of cases of movable kidney treated by operation; in all cases the symptoms were relieved and there were no deaths. It is to be noted that this is one of many operations in which, for some reason, great relief or complete disappearance of symptoms follows merely an exploratory incision. Sir William Stokes[3] has recently recorded such a case, and in an article on "The Supposed Curative Effects of Operation *per se*"[4] I brought together a number of similar cases. It may be that in some cases the kink in a ureter is removed during manipulation, or that perhaps the incision through the kidney capsule (ordinarily made for exploratory purposes) causes relief of tension, or that the incision divides nerves which may have been the subject of lithæmic irritation, and thus simulated movable kidney. Whatever the explanation, the fact remains that in the majority of these cases, even when no true abnormal mobility of the kidney is found to exist, great relief follows the operation.

Lucas[5] recommended a simple incision down to the kidney by a lum-

[1] *Journ. de Méd., de Chir. et de Pharm.*, Bruxelles, 1895, tome iv. fasc. 2.
[2] *Surg. of the Kidneys.*
[3] *Brit. Med. Journ.*, April 20, 1895.
[4] *Ann. of Surgery*, July and August, 1891.
[5] *Brit. Med. Journ.*, Sept. 29, 1893.

bar cut. It may be that this acted not by fixation through cicatricial contraction, as was supposed, but in one of the ways above mentioned.

When the operation of nephrorrhaphy has failed to ameliorate the symptoms, even after it has been tried twice, then only is the operation of nephrectomy or extirpation of the kidney justifiable.

Nephrectomy was first successfully performed by Gustav Simon in 1869 to relieve a urinary fistula in a woman. Since that time the operation has been done many times for the relief of the various surgical diseases of the kidney. The mortality has been always high, varying somewhat, however, with the gravity of the disease. It stands to reason, that when the kidney itself is not organically diseased the operation will meet with greater success, and there will be more likelihood that the other kidney will be able to sustain its increased work. In a table of nephrectomies given by Newman,[1] out of 324 nephrectomies performed for various surgical diseases, including tumors, there were 123 deaths, or a percentage of 37.96. (Newman gives the percentage as 35.2, probably a typographical error.) In the same table there are recorded 30 cases of nephrectomy performed for movable kidney; in 9 cases death resulted, or in 30 per cent. Gross[2] gives the mortality as 40.9 per cent. in nephrectomy for painful movable kidney. The operation is justifiable only when, in the last resort, there is reasonable assurance that there is another kidney, and that it is able, presumably, to sustain the extra strain.

There are three places at which the incision may be made for nephrectomy—namely, in the linea alba, as in an ordinary laparotomy; in the linea semilunaris; and in the lumbar region, as in the operation for nephrorrhaphy. The lumbar incision is certainly to be preferred when the operation is undertaken for the relief of movable kidney; in all probability the organ will not be above normal size. The incision should be about four inches long, beginning about two and a half inches from the spines of the vertebræ, and running parallel to the twelfth rib, and a full half inch below it, in order to avoid any possible chance of wounding the pleura, which sometimes extends quite down to the twelfth rib. This wound may be enlarged, if necessary, by another incision at right angles and extending down to the crest of the ilium. When the kidney has been exposed, as in nephrorrhaphy, and freed from any adhesion with its fatty capsule, it should be drawn into an accessible position in the wound, and a double ligature passed between the vessels and the ureter as deep down as possible; the vessels and the ureter are then tied off separately. The kidney can then be drawn out of the wound, and the vessels and ureter tied off again near the pelvis of the kidney to prevent escape of urine into the wound, and the pedicle cut between the two ligatures. The wound should be irrigated with sterilized water or sublimate solution and packed with iodoform gauze, or it may be partially closed and drained with a rubber tube, which should be removed in three or four days.

Nephrectomy through an incision in the linea semilunaris is known as Langenbuch's operation, and is chiefly used for renal tumors, cysts, etc., whereby the organ has become so large that it cannot be extirpated through the lumbar wound. The length of this incision will depend

[1] *Surg. Dis. of the Kidney*, 1888, p. 437. [2] *Trans. Am. Surg. Ass'n*, 1885.

upon the size of the kidney, but should be always made large enough to allow free manipulation. When all bleeding points have been secured and the abdominal cavity has been opened, as in all other laparotomies, the intestines should be pushed aside and the examination extended to the opposite kidney, not only to make sure of its existence, but, furthermore, to ascertain its condition of health and whether or not it can endure the strain of double duty. If it be absent or diseased, the operation must be abandoned. The possibility of this examination of both kidneys is the chief recommendation of Langenbuch's operation. If the examination of the kidneys prove satisfactory, then the intestines are pushed aside from the affected kidney and the posterior layer of the mesocolon is exposed, and a vertical slit cut in it over the kidney. The anterior edge of the peritoneal wound should then be tightly stitched to the anterior edge of the first incision through the peritoneum at the linea semilunaris.

When this has been done the operation is to all intents performed extraperitoneally. The kidney is then enucleated, as in the lumbar operation, from its fatty capsule and from its fibrous capsule, when the latter is thickened and adherent to the abdominal wall through inflammation, and the vessels and ureter tied off and divided as has just been described. It is also advisable in this operation to provide drainage through the abdominal wound for three or four days.

In abdominal nephrectomy performed through an incision in the linea alba the operation is exactly the same as an ordinary abdominal section up to the point when the mesocolon is incised in order to get into the postperitoneal kidney space. Thereafter the procedure is the same as in Langenbuch's operation. Profuse hemorrhage from cutting one of the large veins running along the anterior layer of the mesocolon frequently happens, and should be prevented by cutting in the line of the veins, or else by tying beforehand those vessels which must be inevitably cut. Drainage should be made through a counter-opening in the lumbar region.

The comparative mortality statistics, for these different operations of nephrectomy in general, are of small value; the different incisions have to meet exigencies of widely different degrees of gravity. In the case, however, of movable kidney alone Newman[1] in a series of 30 cases gave 15 recoveries and 9 deaths in abdominal operations; the lumbar operation was performed 6 times without a death.

With the progressive improvement in the surgical details of abdominal operations, the anterior or transperitoneal incision for nephrectomy has been advancing in favor. It may be said in general terms to be the operation of choice in large solid tumors; in cases where, from the quantity or character of the urine, the existence or condition of the other kidney is in doubt; in cases where extremely extensive adhesions bind the kidney far up under the twelfth rib. It is contraindicated in the presence of suppurative disease, and if performed under these circumstances should be almost always followed by lumbar drainage.

Trendelenburg's position will facilitate the operation in cases of tumor, and has, as Abbe has pointed out,[2] the advantage of giving natural drainage of the tumor itself before removal.

[1] *Surg. Dis. of the Kidney*, p. 437.

[2] *Ann. of Surg.*, Jan., 1894.

Beyond these general directions it does not seem worth while to make a comparative study of mortality tables. The death-rate varies more with the character of the disease than with the method of operation, and, as Tait says, "the kidney is best reached by the most likely-looking road."

As to the general mortality of the operation, it has not varied much of late years. Belfield's figures (May 14, 1887) are still approximately correct. He says: "Of some 250 cases of nephrectomy heretofore reported, about 44 per cent. have died from the effect of the operation. The chief causes of death have been—1, shock (42 per cent. of the fatal cases); 2, uræmia (14 per cent.); 3, peritonitis (21 per cent.). Improvement in the results of renal surgery seems, therefore, to require means for the avoidance of these three chief dangers. The chances of fatal shock are decreased by early operation, before the patient becomes exhausted and the destruction of kidney-tissue extensive. This self-evident proposition is illustrated by the fact that while about 18 per cent. of all (250) reported nephrectomies have died of shock, yet after 24 incisions of sound kidneys in healthy persons—removed for wounds of the loin or ureter, mobility, etc.—not a single death occurred from shock."

Injuries of the Kidneys.

Injuries of the kidneys, like those of other internal organs, may be divided into two main groups—namely, (1) *subparietal*, when there is no external wound leading down to the kidney, and (2) *penetrating*. The first group (1) includes injuries in three degrees of severity—namely, (*a*) contusion and bruise; (*b*) laceration; and (*c*) complete rupture of a portion or of several portions of the kidney-substance. The second group (2) includes: (*a*) wounds in the lumbar region, with penetration or with laceration of the kidney or its pelvis; (*b*) wounds in the lumbar region, with protrusion of the kidney intact; and (*c*) wounds with both protrusion and laceration of the kidney. Another group there is of complicated injuries where other organs are involved, but a discussion of this group belongs to the surgery of the abdomen and does not come within the scope of the present article.

(1) Subparietal injuries result either from *external violence*, such as blows or crushings in the lumbar or the abdominal region, or from *internal strain*, induced by unusual flexion or contorsion of the body, or, in cases of violent shock from falls, by sudden compression from other organs, such as from the liver. The extent to which the abdominal viscera may be lacerated merely by violent flexion of the body is shown in a case by Wharry,[1] where the patient fell from a window, and, striking on the right side of the head and shoulder, the trunk was suddenly and violently bent upon itself. At the post-mortem the liver, the lung, and the kidney on the right side were found to be extensively lacerated, the kidney being almost completely torn asunder, and yet there was no injury apparent in any part of the thoracic or abdominal walls.

Of the two classes of injuries, subparietal injuries are much the more common and are usually far less dangerous.

Symptoms.—Simple subparietal contusion of the kidney without

[1] *Brit. Med. Journ.*, June 14, 1890.

laceration may cause prostration and severe lumbar pain greatly in excess of what might be supposed from the slight extent of the injury when seen by chance upon the post-mortem table. The cortex may be merely bruised, not lacerated, from the blow or other external injury, and yet the patient complains of violent lumbar pain and the urine may be deeply colored with blood. This is particularly noticeable when the anterior surface of the kidney in the neighborhood of the hilus has been the seat of injury. The urine may be suppressed totally for many hours following the injury, or suppression may not come on till later by some hours. The face bears an anxious expression, the pulse is rapid, and there is often a mild degree of fever. These symptoms are the main indications of injury of the kidney, and are in general common to all degrees of subparietal injury, albeit they are much augmented and pronounced in cases where extensive laceration has taken place.

Hæmaturia, it must be remembered, may follow an injury to the abdominal walls, and does not necessarily indicate that the substance of the kidney has been even bruised. Sudden muscular action, for instance, may set free a small encysted calculus or dislodge a pre-existing thrombus, or the blood may fill the pelvis of the kidney simply by transudation from the blood-vessels, and yet no perceptible rupture exist in the kidney. The hæmaturia which results from contusion or laceration of the kidney is usually very profuse, and comes on either immediately after the injury or a few hours later, and persists for several days; or it may be profuse for a day or two, and then suddenly cease, owing to the stoppage of the ureter by a clot: should this clot finally pass through the ureter, attended with a violent attack of renal colic, the hæmaturia will probably recur and thus assume an intermittent type. Occasionally the clot does not pass the ureter, but occludes it permanently, and hydronephrosis or atrophy of the kidney results. In a case reported by Butler[1] the left ureter became completely occluded by a clot on the fourth day after the injury; this was followed by a total suppression of urine for fourteen days, and ended in death. At the necropsy the right kidney was found to be cystic, and so far atrophied as to weigh only 120 grains, or about an eighteenth of its normal weight. The left kidney was enlarged and bound down by old and recent inflammatory changes. The ureter was distended with urine and completely blocked about halfway down by an inspissated clot, which had made its way into the pelvis of the kidney through a large rent extending from one of the calyces far up into the softened renal tissue. It is also noteworthy that both suprarenal bodies were decidedly atrophic, although no other signs of Addison's disease were present.

The hæmaturia, instead of diminishing as the days go on, may suddenly increase to a dangerous degree. Henry Morris quotes a case by Reeves[2] where, after nine days of very slight hæmaturia, the patient passed almost pure blood from the urethra, and died at the end of the fourth week. At the autopsy most of the right kidney was found to be a broken-down pulp situated in a large retroperitoneal space filled with blood and clot. Hæmaturia by no means follows every laceration of the kidney even when the laceration has been extensive; it may be entirely

[1] *Lancet*, Jan. 11, 1890.

[2] *Lancet*, Oct. 4, 1884.

absent, or else not manifest itself until many days or weeks afterward. Morris[1] states that "in complete rupture, when the kidney is divided in two parts, blood is frequently absent from the urine." In severe injury the ureter may become immediately blocked by a detached fragment of renal tissue, and thus blood is wholly prevented from entering the bladder; and when both kidneys are injured there is also likely to be total suppression of the urine. Frequent and painful urination is not an uncommon symptom when blood is being passed through the ureter in the shape of clots which act as foreign bodies in the bladder and create an almost constant desire to urinate.

Pain is almost always the first symptom of injured kidney; it is felt most acutely in the loin, but is oftentimes referred to the inside of the thigh or to the knee or to the testicle, which is usually retracted. The lumbar region and the abdomen on the affected side are excessively tender, and yet may show no bruise. There are also acute paroxysms of pain, sometimes causing nausea and vomiting, which are brought on by the passage of clots of blood through the ureter. Pain is rarely absent, albeit several instances are on record in which this was the case, notwithstanding severe lacerations of the kidney. Such a case is mentioned by D'Arcy Power,[2] where pain was entirely absent, and hæmaturia persisted for only two days, although there was extensive laceration of the kidney-substance.

Hemorrhage into the surrounding tissues or beneath the capsule of the kidney often constitutes a serious condition. It generally becomes apparent soon after the injury, and is manifested by the usual signs of internal hemorrhage—cold extremities, pallor, and collapse—and in addition there is an extensive and increasing area of dulness and swelling in the lumbar and possibly in the iliac regions. In order to distinguish between perinephric effusions of blood or urine and intrarenal distentions, Rayer draws attention to the fact that in intrarenal distention the swelling will be sharply circumscribed, and will form more slowly and probably later than in circumrenal extravasation of blood and urine.[3] Hemorrhage confined within the pelvis of the kidney and ureter seldom forms a tumor appreciable during life, unless it finds its way up under the fibrous capsule when the kidney has been originally much lacerated by the injury which renders the capsule easily separable, and the renal tissue soon becomes totally disorganized. This is, however, a rare occurrence. The sac formed by the capsule and perirenal tissue may become so distended that it ruptures into the peritoneal cavity—a complication which is almost sure to be rapidly fatal. Intraperitoneal hemorrhage usually makes itself known much more quickly than a retroperitoneal hemorrhage by the development of tympanites and signs of peritonitis, together with the other signs of internal hemorrhage; the surgeon must of course at once intervene.

Although the hemorrhage is wont to occur immediately after the injury, nevertheless several cases of secondary hemorrhage have been reported; in one reported by Rayer[4] hæmatoma was not observed until six weeks after the injury.

[1] *Dis. of the Kidney*, 1885.
[2] *Lancet*, Feb. 8, 1890.
[3] *Traité des Maladies des Reins.*
[4] *Op. cit.*

Tuffier and Levi have described[1] under the name "perirenal uro-sanguineous effusions" a condition which they think worthy of special notice. They report two cases which, in conjunction with those of Monod[2] and of Peyrot,[3] establish as follows the symptomatology and course of this lesion: A blow or a strain is followed immediately by hæmaturia, often profuse and lasting for five or six days. There is, however, no relation between the abundance or the duration of this hæmaturia and the importance of the traumatism. It is often associated with lumbar pains and with attacks of pain resembling nephritic colic. A little later a large lumbar swelling appears, vaguely defined and extending from the twelfth rib to the crest of the ilium. There may be a slight elevation of temperature. After the first week the urine will probably become clear. The swelling, however, persists. From the middle to the end of the second week the hæmaturia reappears and the tumor vanishes. The blood in the urine at this time is evidently not freshly poured out, but is dark in color and deposits a brownish sediment, instead of clots, when the urine is allowed to stand. These symptoms may be followed by a passing polyuria. During the first week it is evident that there has been a hæmaturia from the kidney or its pelvis, evacuated in part by the ureter and in part forming a perirenal swelling. The hæmaturia ceases when the swelling reaches its maximum of tension. This is followed for some days by a sufficient reopening of the kidney-wound to permit of the spontaneous evacuation of the larger part of the effused blood. The reappearance of blood in the urine during the second week is therefore, according to Tuffier, a favorable symptom, and indicates the spontaneous evacuation of the blood from around the kidney. He advises in the treatment of these conditions absolute rest, the application of ice-bags, moderate compression by means of a flannel bandage, and small doses of opium. He emphasizes the need of the most perfect asepsis if a catheter becomes necessary.

Complications which may arise in subparietal injuries are—

(*a*) *Perinephritis* from the extravasation of blood and urine into the perirenal tissues, when the urine rapidly decomposes and a purulent process is set up, converting the perirenal tissues into a large abscess-cavity;

(*b*) *Hydronephrosis*, as a consequence of the blocking of the ureter by a clot;

(*c*) *Pyonephrosis*, the inevitable result when the pelvis and ureter become distended with urine and blood, and the urine decomposes;

(*d*) *Cystitis* is a complication of great gravity in all diseases of the kidneys, and in many cases leads to septic infection; in cases of injury it may result in the destruction of the remaining sound kidney. It may be incited by the obstruction and iritation caused by retained clots of blood or by the attempts to remove them with an unclean catheter;

(*e*) *Traumatic peritonitis* may be caused by the extravasation of blood and urine from a wounded kidney through a rent in the peritoneum;

(*f*) *Thrombosis* of the renal vessels.[4]

[1] *La Presse médicale*, April 27, 1895.
[2] "Pseudo-hydronéphroses traumatiques," *Ann. Gen.-urin.*, 1892.
[3] *Bull. Soc. Chir.*, March 21, 1894.
[4] Reported in two cases, *Guy's Hosp. Rep.*, series iii. vol. xiv.

Treatment.—Absolute rest in bed, liquid diet, the avoidance of stimulants (which increase the secretion of urine), and the administration of anodynes to allay the pain are the first requirements in the treatment of suspected injury of the kidney. When the hemorrhage into the bladder is excessive, fluid extract of ergot, given in one-half drachm doses every two or three hours, has been thought to be efficacious; as adjuvants to the ergot, cold applications, such as ice-bags or Leiter's coils, to the lumbar region, may be added, and strapping the affected side with long strips of adhesive plaster, as applied for fractured ribs, will frequently greatly alleviate the pain. Hemorrhage is the most serious symptom, and to the control of it the greatest attention should be directed; in addition to the application of cold and the internal administration of ergot, hypodermic injections of ergotine or ergotinine may be tried with advantage (Le Dentu). The alimentary canal must be kept as completely at rest as possible, and if there be nausea and vomiting, it is best to give nourishment in the form of nutritive enemata, but in other respects the bowels should be kept inactive. On this point Morris[1] is emphatic, since he has seen hemorrhage brought on more than two weeks after an injury by the passage of solid fecal matter through the colon, thereby giving rise to pressure against the kidney. The importance is therefore manifest of enforcing a liquid diet during three weeks, at the least, after a suspected injury to the kidney. Every effort should be made to keep the bladder free from the clots of blood which have passed down from the kidney; they are apt to block the orifice of the urethra, and by the irritation thus excited a cystitis is more than likely to follow, and by extending up the ureter excite a pyonephrosis in the uninjured kidney, which in the disorganized condition of the urinary apparatus is almost inevitably fatal, even though nephrotomy and drainage be performed. Boric acid or salol or benzoic acid, the most trustworthy urinary antiseptics, should be invariably administered in these cases.

If the clots be too large to be passed naturally through the urethra, or if there be spasmodic retention of urine, the clots must be broken up and evacuated through a large-sized catheter or through a Bigelow's evacuator, as used in litholapaxy. It has been suggested that this will be facilitated by the injection of a solution of pepsin or of some other digestant and liquefier of the blood-clot. If these means fail to keep the bladder in a healthy condition, it is best to perform median or lateral cystotomy for drainage. This operation is a last resource in cases of retention, but it had better not be postponed until a cystitis has developed or the patient is weakened by hemorrhages and by straining. When the hæmaturia persists in spite of all efforts to arrest it, and the loss of blood daily weakens the patient, nephrectomy is justifiable, provided, of course, that there is fair evidence of the presence of the opposite kidney and of its healthy capacity for double duty. A number of cases demonstrate that this kidney, if normal, will at once assume this duty and carry on the secretion of urea with sufficient activity to ensure recovery in the absence of other complications.

Foshay[2] studied the changes in the urine after nephrectomy in two cases, and in both found evidence of temporary hyperæmia of the remaining kidney. He says: "In both cases the maximum daily average of

[1] *Surg. Dis. of the Kidney.*

[2] *Internat. Med. Mag.*, Nov., 1893.

quantity excreted occurred in the third week. The maximum daily amount of solids was reached in the fourth week of the first case and third week of the second, the maximum in the sixth week of the latter case merely indicating the re-establishment of normal diet and function. The maximum of urea will be found in the third week of the first case and the second week of the second case. In each case the urea reached its maximum one week before the total solids attained a maximum—an interesting fact, but difficult of explanation."

Meyer,[1] after reporting a case of anuria following nephrectomy in which nephrotomy was performed, remarks: "There evidently occurs an excessive hyperæmia in the remaining kidney immediately after nephrectomy. Its presence is demonstrated by the sudden change in the transparency of the urine if that remaining kidney had already been slightly affected. It has been observed by many who have done several nephrectomies that in a number of cases immediately after the one unhealthy kidney has been removed the urine which descends from its probably only slightly affected fellow, and which had formerly been found comparatively clear, with the help of cystoscopy or after nephrotomy on the other side had been done, suddenly becomes very turbid, and presents an unusually heavy deposit after short standing. As I have seen, it can take weeks or months before this turbidity lessens or disappears. In the majority of cases it does so, however, but slowly and gradually."

Schede[2] also mentions this arterial pressure, necessarily present and suddenly increased, in the remaining kidney after nephrectomy on the opposite side. He is inclined to look at it as the probable cause of the acute epithelial necrosis ("Coagulations-nekrose") in the tubuli contorti of the kidney, which has been found on microscopical examination of the remaining kidney, in a few instances after nephrectomy and to which the immediate fatal result of the operation evidently was due.

Meyer quotes a similar case of Bardenheuer's[3] and one of Lang's,[4] and arrives at the following conclusions as to the prevention and treatment of this unfortunate sequel of nephrectomy: "1. Before nephrectomy, cystoscopy should, if possible, be performed to prove the presence of an active opposite kidney. 2. This will be generally unnecessary if a renal fistula exists on the diseased side, and the urine, voided *per urethram*, is clear and sufficient in quantity. But even in these cases cystoscopy will be a desirable procedure for making a more definite prognosis. If the cystoscope had demonstrated the presence of an active opposite kidney, and if then absolute anuria suddenly sets in some time after nephrectomy and a period of uninterrupted recovery with the secretion of a satisfactory amount of urine, the cause must be a mechanical one. Nephrotomy on the remaining side is then indicated as the only means to save the patient's life. 3. Immediately after nephrectomy there is, in all probability, an acute hyperæmia of the opposite kidney. This hyperæmia also frequently occurs in the female sex, especially in the left kidney, at the time of the menstrual period, but probably to a much less extent. 4. Such hyperæmia may suddenly

[1] *Ann. of Surg.*, April, 1892.
[2] *Meine Erfahrung über Nieren Extirpationen, Sep. abd. a. d. Festschrift zur Eroeffnung des Krankenhauses*, Hamburg, 1889, p. 45, foot-note.
[3] *Centralblatt für Chirurgie*, 1882, No. 12.
[4] *Med. News*, 1886, p. 69.

increase an incipient or hitherto entirely latent disease in this remaining kidney. It can even cause the perforation into the pelvis of the kidney of an abscess previously encapsulated in one of the pyramids. 5. Such an aggravation of disease in the remaining kidney may be repeated at a number of menstruations, but is, in the majority of cases, of a passing, not of a permanent, character. After such attacks the remaining kidney often shows an improved condition."

But, after all, whether or not to perform nephrectomy must always remain a most difficult question; in many cases severe hemorrhage into the bladder ceases spontaneously or yields, within one or two days, to external and internal measures. Children are much less able than adults to resist internal hemorrhage, but are, apparently, quite if not better able than adults to recover from the effects of nephrectomy. As regards children, therefore, the question is much less serious, and in them nephrectomy should not be delayed in cases of uncontrollable internal hemorrhage from ruptured kidney. In one of Obalinski's cases[1] the indication which guided him to perform nephrectomy was the formation in the right hypochondrium, on the ninth day after the injury, of a tender circumscribed tumor the size of a child's head. The kidney was immediately exposed by a lumbar incision, and found almost completely severed and surrounded by a large quantity of healthy urine and small blood-clots. The fragments were removed, the pedicle tied off, and the wound plugged with iodoform gauze. The patient made a good recovery. In cases, after an injury to the kidney, of rapidly-forming tumor, and where there is profuse hæmaturia and other indications of severe hemorrhage, Obalinski is in favor of exposing the kidney at once by a laparotomy. The abdominal incision furnishes an opportunity of washing out the peritoneal cavity in case it, too, has been wounded and contains blood or extravasated urine.

Owing to their depth and inaccessibility, an attempt to tie the deep-seated arteries whence the hemorrhage proceeds is almost futile; furthermore, such a tying would involve a large portion of the supply of blood to the kidney. Partial resection of the renal substance was successful in a case related by Bardenheuer,[2] where the lower third of the kidney (which, however, was not lacerated, but riddled with abscesses the result of calculi) was successfully removed. He also mentions another case where the lower end of the left kidney was detached by an injury, and two weeks later was removed successfully.

The treatment of the other complications, such as hydronephrosis, pyonephrosis, and perinephric abscess, will be found included under the description of those diseases.

(2) Penetrating Wounds of the Kidney.—As has been mentioned above, penetrating wounds of the kidney may be of three kinds: (*a*) wounds in the lumbar region, with penetration or laceration of the kidney or its pelvis; (*b*) wounds in the lumbar region, with protrusion of the kidney intact; and (*c*) wounds with both protrusion and laceration of the kidney.

(*a*) The deep-seated position of the kidney is its protection from punctured or incised wounds inflicted by sharp instruments, but on

[1] *Sammlung klinischer Vorträge*, No. 16, new series.
[2] *Deutsche med. Woch.*, Nov. 4, 1891.

battlefield bayonet or gunshot wounds of the kidney are by no means uncommon, and, moreover, they are frequently complicated by wounds of other organs or of the peritoneum; hence their fatality.

Simple penetrating wounds are those which are extraperitoneal; they implicate only the body of the kidney and do not encroach upon the pelvis or ureter.

Simultaneous wounds of the peritoneum or abdominal organs form serious complications, which are usually inevitable when the wounding instrument penetrates from in front or traverses the abdominal cavity from behind. In addition to wounds of the peritoneum, the renal wound may be complicated by the laceration of large blood-vessels or of the ureter.

Symptoms.—When an external wound exists in the lumbar or in the hypochondriac region the evidence is usually soon manifest whether or not the wound extends to the kidney. The urine is immediately, in all but rare instances, highly colored with blood, unless the wound is very slight and involves only the cortex, and the patient almost invariably feels excruciating pain in the renal region. In addition to this, there are the location, depth, and direction of the external wound to guide us. Bruce Clarke states[1] that the presence of blood in the urine and of urine in the lumbar wound are the only two symptoms from which an absolutely certain diagnosis can be made. This is true in so far as the presence of urine in the lumbar wound is significant of renal injury, but the absence of blood in the urine, or of urine in the lumbar wound, does not by any means indicate that the kidney has not been wounded. Urine will only make its way into the external wound when the laceration extends deep into the kidney-structure and penetrates to the pelvis of the kidney or to one of the calyces. Furthermore, urine may make its way into the lumbar wound when the ureter alone is ruptured, and, if only partially torn across, a considerable amount of blood will probably make its way into the bladder.

In addition to all the symptoms above enumerated under Subparietal Lacerations, the symptoms of penetrating wounds may be complicated by the presence of foreign bodies which became lodged in the kidneys at the time of the injury. A remarkable case of this nature is reported by Hennen,[2] where the patient had received a gunshot wound in the right hypochondrium, which was followed by hæmaturia and peritonitis; seven weeks later an abscess formed at the site of the wound and was opened; it contained six ounces of pus having a urinous odor; shortly after this another abscess formed lower down, and it also contained urinous pus; symptoms of renal colic then set in, and finally, at the end of seven months after the infliction of the wound, there was passed *per urethram* a piece of cloth covered with black grit. Rapid recovery followed. A similar case is recorded by Demme.[3]

As to gunshot wounds, Morris states that the great distinction between them and incised wounds lies in the likelihood of rapid and aseptic healing in the latter; whereas the wound inflicted by a bullet is inevitably followed by more or less sloughing and suppuration, with all the risks these processes entail.

[1] *Surgery of the Kidney*, 1886, p. 37. [2] Quoted by Morris, *Diseases of the Kidney.*
[3] Quoted by Stimson, *Morrow's System of Gen.-urin. Dis.*, vol. i. p. 754.

Richardson [1] has shown that in 31 cases of penetrating knife-wounds of the abdomen only 7 died. The comparison holds good in cases of renal wounds.

Treatment.—Wounds leading down to the kidney must be treated on general principles as applied to other wounds involving the deep structures. Should there be a leakage of urine, the wound must be kept open and freely drained until the question of nephrectomy is settled. The discomfort attending a urinary fistula, to be dreaded after prolonged drainage, is comparatively slight in comparison with the danger of allowing the urine to extravasate into the perirenal tissues or form a perinephric abscess. If the kidney be reduced to pulp or lacerated to such an extent that it cannot possibly resume its function, nephrectomy should be performed without delay. Again, as in subparietal wounds, if hemorrhage into the perirenal tissue and through the ureter is persistent, it is probable that a large branch of the renal artery has been divided, and the only means of controlling the hemorrhage will be removal of the kidney and ligation of the vessels in a mass.

(*b*) Penetrating wounds with protrusion of the kidney intact are of rare occurrence; Le Dentu mentions 4 cases,[2] and Tuffier [3] has collected 7. The following three rules to be observed in such cases are laid down by Le Dentu.[4] First: When the wound is of very recent infliction the kidney should be replaced and sutured in position or held in by tampons after thorough antiseptic washing both of the organ and its surroundings. Second: For wounds several hours old, and whether the protruded kidney be wounded or intact, immediate nephrectomy is to be performed. Third: Disregarding the duration of the wound, if the protruded kidney be extensively broken up, nephrectomy should be performed without delay. In Schelldorf's case (quoted by Le Dentu), the recently protruded and uninjured kidney was replaced and ice applied; recovery was prompt and complete. In another case, reported by Vernon [5] and quoted by Bruce Clarke,[6] the kidney was wounded and protruded slightly; bloody urine trickled through the wound as well as through the ureter; the patient, however recovered in about two months. In a third case, quoted by Le Dentu, also by Morris,[7] the patient was not seen by the surgeon, Brandt, until the kidney had been exposed for twenty-four hours; no attempt was therefore made to replace it, but, for some reason not recorded, he did not extirpate the kidney until three days later; nevertheless, the patient made a good recovery in twenty days. In the fourth case, quoted by Le Dentu, the kidney had been exposed some time; it was therefore not replaced, but the pedicle was tied off by degrees and was allowed to separate by sloughing—a most tedious, not to say dangerous, proceeding.[8]

(*c*) Having set forth the symptoms and treatment under both protrusion and laceration, any separate observations under this head (which includes the two) are really superfluous; and finally be it here said that the sum and substance of all surgery in this regard is comprised in the supreme rule that every human endeavor should be made to save a

[1] *Trans. Amer. Surg. Assoc.*, 1887.
[2] *Affections chirurgicales des Reins*, etc.
[3] *Archiv. gen. de Méd.*, 1889.
[4] *Op. cit.*, p. 28.
[5] *St. Bart. Hosp. Rep.*, 1866, p. 124.
[6] *Surg. of the Kidney.*
[7] *Op. cit.*, p. 184.
[8] Marvaud, *Recueil de Mém. de Méd., de Chirurg., etc.*, vol. xxxi., 1875; also Morris, *op. cit.*

kidney still capable of carrying on its functions, but if this hope be utterly gone, then nephrectomy should be performed without delay.

Renal Calculus.

Nephrolithiasis, or the tendency to form renal concretions, is obscure in its etiology; whether this tendency be due to constitutional disturbance tending to an over-elimination of urinary salts, or whether it be due primarily to a diseased kidney which fails to perform its proper functions, is a question of doubt. On the one hand, it may be urged against its being a constitutional disturbance that renal concretions are oftenest formed in but one of the kidneys, hence in that kidney the formation of calculi must demonstrate a purely local and not constitutional disorder. On the other hand, it may be said in favor of constitutional disturbance that the tendency to nephrolithiasis has been very often inherited. It is easier and probably more correct to say that the formation of renal calculi is due both to local and constitutional disorders. The way in which these two causes act in combination is well explained by Ord and Rainey, as quoted by Cabot.[1] When, owing to a constitutional defect, the normal amount of salts in food cannot be properly assimilated, the elimination of these salts becomes a task beyond the power of the kidneys. The sharp crystalline spicules then formed in the urine in an almost saturated solution irritate the epithelium of the fine renal tubules; from this irritation a slight oozing of blood ensues, and an albuminoid or a colloid substance thus becomes the nucleus round which the crystalline substances agglomerate and assume gradually a rounded shape. That calculus-formation is thus due to a combination of causes, and not to a constitutional diathesis alone, is proved by the fact that even when uric acid is not found in excess in the urine uric-acid calculi may still be formed.

As to predisposing causes, it may be observed that those who lead sedentary lives, and indulge in high living are more liable than others to urinary concretions; the frequency with which renal calculi are found among the children of the poorer classes has been attributed to poor hygienic surroundings and to coarse diet. It is believed to be largely due to the absence of milk from the diet of such children; this, an original observation of Mr. Cadge, is well illustrated by the story which he has published in corroboration: "A few years ago, after removing a stone from a child of well-to-do parents, I was remarking to one of my assistants that this was the first instance in my practice, and that I attributed the general absence of stone in such persons to the free use of milk; the mother volunteered the statement that in a large family this was her only child who never could take milk, and who, therefore, had never had any."

The urinary salts composing renal calculi and those composing vesical calculi are the same. Some of these salts are normal constituents of the urine, others are solely pathological.

The following table, showing the comparative frequency of the different varieties of renal and vesical calculi, is by Newman.[2] They are arranged in the order of their frequency.

[1] *Morrow's System*, vol. i. 621.

[2] *Surg. Dis. of Kidney*, 1888.

Uric acid and phosphates	61
Phosphatic (simple)	32
Uric acid, oxalate of lime and phosphates	32
" " (simple)	26
" " and oxalate of lime	21
Oxalate of lime and phosphates	19
" " " (simple)	12
Uric acid and urate of ammonia	3
" " urates and phosphates	1
Cystine (simple)	1
	208

From this table it is seen that uric acid in combination with phosphates forms 29.28 per cent. of the urinary calculi, and that simple uric acid is found in 12.5 per cent. This is slightly at variance with Dickinson,[1] who finds that out of 91 renal calculi contained in the pathological museums of London 20.8 per cent. were composed of uric acid in combination and 23.07 per cent. were composed of simple uric acid, giving a predominance of simple uric-acid calculi over the compounds. A more minute description of the various forms of urinary calculi will be found in the article on Vesical Calculi.

In dealing with renal calculi the degree of hardness, unlike vesical calculi, is of no moment; owing to their position, it is impossible to crush and wash them away from the pelvis of the kidney; they must be either removed entire or, if soft and friable, be broken up and removed with a scoop. Renal calculi which, owing to their size, are unable to slip through the ureter into the bladder, and consequently lodge in the pelvis of the kidney, probably originate in one of the renal calyces, and, becoming detached, fall into the pelvis, and there serve as a nucleus for the deposit, layer upon layer, of the urinary salts. It is also possible that calculi may originate in the renal pelvis about a minute blood-clot, a bleeding point, or about a semi-detached fragment of the epithelial lining. Foreign bodies serving as nuclei are extremely rare, as may be supposed, owing to the deep position of the kidney. Franks has reported a case, however,[1] where an ordinary sewing needle formed the nucleus of a renal calculus which produced an extensive perirenal abscess. The needle had been swallowed in childhood, and, by that peculiar propensity to wander which needles have when once fairly under the skin, this needle had finally penetrated the pelvis of the kidney and there become encrusted with urinary salts. The patient made a good recovery after the calculus was removed and the abscess-cavity drained by a lumbar incision.

Nuclei commonly consist of uric acid or blood-clot, quite frequently of a mere agglomeration of epithelial cells and crystals of the urinary salts. There may be many, even up to two hundred, small calculi, or again there may be but one. In shape they are seldom round or regular owing both to the irregular shape of the cavity wherein they are contained and to their extremely restricted attrition from motion. One large calculus and numerous small ones may be found filling up the renal pelvis; the larger calculus, acting as a ball-valve, partially closes the entrance to the ureter and allows only occasionally a smaller calculus to pass down. Such may be the case when frequent attacks of renal colic are followed by the passage of a small calculus *per ure-*

[1] *Renal and Urinary Affections*, iii. p. 864. [2] *Brit. Med. Journ.*, July 5, 1890.

thram, not followed by the usual amelioration of general symptoms. Calculi may be also found firmly moulded round the renal calyces in the hilus, branching and bifurcating not unlike a fragment of coral; or they may be imbedded in the renal tissue proper, in a cavity which may or may not communicate directly with the renal pelvis.

Probably the largest single calculus which has been successfully removed from the kidney by the operation of nephrolithotomy is reported by Gay in 1892.[1] It weighed when removed five ounces, and was seven inches in circumference and two inches and three-quarters in diameter; it was composed chiefly of phosphates, with a small amount of carbonate of lime. From this size these calculi range down to minute granules; the smallest single calculus which has been removed by operation, according to Tiffany,[2] was composed of oxalate of lime and weighed twenty-six grains; it was removed by Howse.

Symptoms.—The guiding symptoms of renal calculus are pain, hæmaturia, pyuria, passage of fragments of calculous material with the urine, frequent urination. As minor symptoms should be mentioned nausea and vomiting and diminution or temporary suppression of urine.

The *pain* occasioned by renal calculus is chiefly centred in the lumbar region of the affected side; it is increased by motion or by exertion or by pressure over the kidney. It is of a constant dull, aching character, usually of many years' duration, with occasional, in some cases frequent, exacerbations. Sudden onsets of pain, occurring during the night when the patient is completely at rest, are not at all uncommon. Jacobson[3] explains these attacks as due either to the passage of flatus in the colon, which presses against the kidney, or, still more probably, to the fresh deposit of salts on the calculi already existing either in the renal pelvis or in one of the calyces. The pain usually radiates from the lumbar region into the testicle, causing violent contraction of the cremaster muscle, with retraction of the testicle; it may also radiate down the course of the ureter, into the thigh, and down to the calf of the leg; and it may be referred to the intestines, producing all the symptoms of violent intestinal colic, together with nausea and vomiting. It may also cause rectal and vesical tenesmus. Lloyd[4] lays considerable stress upon the characteristic "stabbing" pain which is caused by deep percussion on the loin of the affected side.

The so-called kidney colic is in the great majority of cases unquestionably due to the passage of a stone or of a fragment of stone along the ureter. But it is quite certain that perfectly typical paroxysms may occur without the presence of any stone. This is proved not only by the large number of cases reported in which, the diagnosis having been based mainly on this symptom, the kidney was opened and no stone found,[5] but also by cases in which, the kidney having been exposed to sight and touch, rhythmical contractions of the ureter were observed. This offers another explanation—that of ureteral colic, which may be

[1] *Boston Med. and Surg. Journ.*, Aug. 11, 1892, p. 134.
[2] *Trans. Am. Surg. Soc.*, 1885.
[3] *Brit. Med. Journ.*, Jan. 18, 1890.
[4] *Practitioner*, xxxix. p. 178.
[5] See Tiffany's paper on "Free Division of the Capsule of the Kidney for the Relief of Nephralgia" (*Trans. Am. Surg. Ass'n*, 1889); Reginald Harrison (*Liverpool Journal*, Jan. 1889); Stimson (*Morrow's System*, vol. i. p. 771, etc.).

excited by divers conditions, and would naturally have subjective symptoms very like those belonging to kidney colic.

Hæmaturia, if persistent, is considered by some authors as the most characteristic symptom, but its paramount diagnostic value may be doubted, so variable is it as a symptom; it is frequently entirely absent from the beginning to the end of the renal disorder, and, again, it may be caused by other diseases, such as tuberculosis of some deep-seated portion of the urinary tract, by passive congestion of the kidney, by renal tumors, by advanced chronic nephritis, by granular kidney, and somewhat rarely by syphilis. Hæmaturia may occur only at long intervals, usually following an attack of renal colic, or it may be constant, either giving the urine a distinctly dark, smoky appearance or else being noticeable only under the microscope. It is usually more marked after exercise, but is never very profuse. Hæmaturia of long standing, where the bleeding has been so profuse as to produce anæmia, is more likely to be due to a renal tumor rather than to calculous deposits in the kidney or its pelvis. The blood is usually intimately mixed with the urine, giving to it a dark, smoke color, or possibly turning it dark brown; it is seen as red blood only when the bleeding has been profuse and the urine is passed shortly after the blood has come down from the kidney, and before it has become discolored by the action of the urine. Blood-clots in the form of casts of the ureter are not uncommonly passed *per urethram*.

Pronounced *pyuria* is evidence of a somewhat serious complication of renal calculus, but is not necessarily a constant symptom. When it is associated with other and more characteristic symptoms, it indicates that septic infection has taken place through the medium of the urine, and that there is danger of a purulent disorganization of the kidney and development of a pyonephrosis. It is, however, quite difficult to determine accurately whence the pus comes, whether from the bladder or ureters. In females this can be decided more readily than in males by catheterization of the ureters. The determination of the source of a pyuria is one of the most useful achievements of the cystoscope. Sudden disappearance of pus from urine, which has been previously loaded with it, indicates that there is probably a stoppage of the ureter from impaction of the calculus therein, and there will, in all probability, be an increase of pain at the same time. The presence of small quantities of pus may be from time to time found in all cases of nephrolithiasis, indicating merely a slight inflammation of the ureter or pelvis of the kidney from irritation.

The Urine.—Besides containing microscopical or macroscopical portions of blood, the urine usually shows by microscopical examination crystals of the salts which are in excess and which probably compose the offending calculus—urates, phosphates, oxalates, etc., blood-casts of the urinary tubules, and not infrequently granular casts. The urine is almost always acid in reaction, and generally contains a trace or more of albumin. Boyd[1] calls attention to the fact that crystals of oxalate of lime are frequently the cause of the so-called cyclical albuminuria; the crystals when in excess in the urine seem to set up a nephritis from irritation.

[1] *Lancet*, Oct. 24, 1891.

Frequent urination, due to a reflex irritability of the bladder from irritation of the renal pelvis and the ureter, is often a troublesome symptom during the daytime, but is relieved when the patient is at rest. Jacobson[1] observes that nocturnal and diurnal frequency of urination (when associated with other symptoms suggesting renal calculus) indicates renal tuberculosis, with extension of the process to the bladder-walls, rather than renal calculus; at the same time the urination is not painful unless there is great straining, which causes increased blood-pressure in the kidney and in the bladder.

"*Nausea and vomiting* habitually accompany the paroxysms, and are probably the result of the pain. Whether or not there is any more direct connection by nerve-reflex between the pelvis or ureter and the gastro-intestinal nerve-centre which would enable irritation or congestion of the former to excite anorexia, nausea, or vomiting, has not been established. Some authors—Torres, Morris—believe there is, and claim that these symptoms are very common at times when the pain is not severe and under circumstances that make such a causal relation the most plausible explanation."[2]

"*Diminution* or *total suppression of the urine*, lasting for a few hours, has been observed, and is attributed to reflex action upon the vasomotor nerves of both kidneys, even when the calculus is unilateral. In the cases in which it lasts a much longer time it must be attributed to the simultaneous obstruction of both ureters or to obstruction of one ureter when the other kidney is congenitally absent or has been incapacitated or destroyed by disease. The occurrence is extremely rare. It may follow a well-marked attack of nephralgia or kidney colic, or may begin insidiously and attract no attention until the symptoms of uræmia set in. The amount of urine passed from day to day may show notable variations, and at times may even be in excess of the normal in consequence of the temporary removal of the obstruction. It differs from the high-colored, scanty urine of partial suppression, and is pale, clear, and of low specific gravity. As time passes the signs of hydronephrosis may appear, to be followed by œdema of the limbs and uræmia. The average duration of life is said to be from ten to fifteen days. In about one-fifth of the cases recovery takes place by spontaneous removal of the obstruction, occasionally by its passage through the ureter."[3]

As in all other diseases, exceptions will occur where none of the symptoms above enumerated will be at all characteristic; the pain may be referred entirely to the opposite side from that in reality affected; and, again, the only symptoms presented may be those of a gastro-intestinal catarrh. Large renal calculi almost entirely filling the pelvis of the kidney have, on several occasions, been found at a necropsy, their presence never having been suspected during life. The single calculus, even when large and rough, if imbedded firmly in the kidney or in its pelvis, does not seem to cause as much pain as the small, smooth calculi which roll freely. Pain, however, is the chief guide in diagnosis: its duration, its seat, its paroxysmal nature, the fact that it is usually brought on by exertion and is aggravated by pressure over the kidney, all are points of cardinal importance, and may form the basis of a

[1] *Brit. Med. Journ.*, Jan., 1890. [2] Stimson, *op. cit.* [3] *Ibid.*

diagnosis of renal calculus sufficiently strong to justify at least an exploratory operation upon the kidney.

Differential Diagnosis.—The several diseases which may closely simulate the symptoms of renal calculus are, chiefly—movable kidney, simple nephralgia, tuberculosis, malignant growths of the kidney or of the adjacent parts, oxaluria, pyelitis, renal and perirenal abscess, and possibly spinal caries on a level with the kidneys.

Movable kidney may cause intermittent attacks of what appears to be renal colic, but there is, only exceptionally, any hæmaturia, and the movable tumor can usually be felt in the loin.

Simple nephralgia, or aching kidney, is a condition which chiefly occurs in women. It may simulate renal calculus in all respects but the presence of blood or pus in the urine. The attacks of pain occur in paroxysms especially marked at the catamenia; there is increased frequency of urination; pain extending down the thighs and into the calf of the leg, accompanied by a dull ache in the loin, increased by exertion. The urine, however, shows no characteristic of calculus; it is apt to be passed in large quantities; it is limpid and does not contain blood or pus; nor is there likely to be any history of previous passage of calculous material.

Tuberculosis of the kidney simulates renal calculus closely in every respect, and it may even require an exploratory incision to confirm the diagnosis. (See p. — for fuller differential diagnosis.) It may be stated in general terms, however, that with a tubercular kidney there is more pus than blood in the urine, whereas in simple renal calculus there is always more blood than pus. In cases of tubercular kidney the pus is thick and contains caseous particles which rapidly settle at the bottom of the jorden. In these caseous fragments the tubercle bacillus may be occasionally observed; its observation, however, is not at all an easy nor always a successful undertaking.

Malignant growths of the kidney and adjacent parts may simulate renal calculus so closely as to baffle the best diagnostician. Possibly the only circumstances which can confirm the diagnosis is the passage in the urine of a fragment of the growth. The hæmaturia is generally very pronounced, and the patient loses constantly so much blood that anæmia ensues, which is never the case with simple renal calculus. In the early stages of such cases an exploratory operation is justifiable.

Oxaluria and *uric-acid diathesis* may produce the paroxysmal pains and slight hæmaturia as well as the dull steady ache simulating nephrolithiasis, but the absence both of increased pain on exertion, as well as of the characteristic "stabbing" pain (mentioned above), together with the fact that amelioration follows appropriate medicine and regulation of diet, are the differential points in the diagnosis.

Simple pyelitis, possibly the sequence of gonorrhœa or perhaps of a mild cystitis, or the result from the passage of a small calculus, is practically impossible to differentiate save by the history. The pain probably will not be so marked by paroxysms as in case of calculus, and there will be more pus in the urine. This, rather than true nephralgia, probably existed in the majority of the cases collected by Tiffany.[1]

[1] *Op. cit. supra.*

Renal abscess, not calculous in its origin, is almost invariably tubercular.

Perirenal abscess lacks the history of renal colic, and is not, unless secondary to renal disease, associated with abnormality of the urine; moreover, it has certain symptoms of its own which will be considered later. (See page 506.)

Spinal caries at a level with the kidneys has been found to resemble renal calculus to a marked degree. G. A. Wright[1] reports a case where an abscess formed in the neighborhood of the carious vertebræ, and consequent pressure on the kidney caused symptoms of renal calculus—viz. increased frequency of urination, intermittent attacks of pain causing nausea and vomiting, testicular pain and local tenderness, and lastly oxaluria. In such cases exploratory operations are justifiable; they are the only means of confirming the diagnosis.

The **treatment** of renal calculus may be considered as threefold—(1) prophylactic; (2) palliative; and (3) radical.

1. *Prophylaxis* consists of simple diet, out-of-door exercise, abstinence from alcoholic drinks; water should be freely drunk, especially lithia or potash-water or the waters of Carlsbad or Friedrichshall, for the uric-acid diathesis, and when the calculus is supposed to be formed of calcium oxalate, nitromuriatic acid and the vegetable bitters may be added.

2. *Palliative* treatment during an attack of renal colic from the passage of a calculus consists in the free use of anodynes. Morphia and other alkaloids of opium, combined with belladonna or its alkaloid, must be employed in repeated doses, not only to mitigate the pain, but also to relax the spasm of the ureter and favor the escape of the calculus into the bladder. They are most effective when used hypodermically.

3. *Radical* treatment consists of removal of the calculus by an incision into the kidney before suppurative or hydronephrotic degeneration has begun, and when there is every reason to believe that the kidney will be functionally unimpaired.

Under palliative treatment for habitual nephrolithiasis should also be included a mention of the use of piperazin, which has had a little temporary vogue, but does not seem to have sustained the reputation it once had. Interesting cases in which it was used are reported by Stewart.[2]

The general directions as to the mode of life of such a patient may be summarized as follows, in addition to what was said under prophylaxis, details being left to the purely medical treatises:

The patients should eat sparingly at all times, and should especially avoid dark meats, sugars, highly seasoned foods, rhubarb, tomatoes, asparagus, strawberries, etc.; also burgundy, champagne, and malt liquors.

They should drink freely of pure waters, which, by decreasing the proportion of salts in the urine, lessen the formation of new calculous material, and by increasing the volume of urine aid in the discharge of any that has already been deposited in the kidney. Potassium citrate, lithium carbonate, and sodium phosphate have seemed to be the most valuable alkaline diuretics.

They should exercise moderately, but not to the point of extreme fatigue or excessive perspiration. Especial attention should be paid to the hygiene of the skin, using dry frictions, and bathing frequently.

[1] *Med. Chron.*, No. 6, p. 642.

[2] *Therapeutic Gazette*, Jan. 16, 1893.

All excesses should be avoided, especially those which may be followed by gastro-intestinal or hepatic disturbances.

NEPHROLITHOTOMY is the extraction of a calculus from an otherwise healthy kidney or its pelvis before suppuration or a hydronephrosis has set in; in the presence of these two diseases the operation for extraction is termed simply *nephrotomy*. This distinction was originally laid down by Morris in 1880, when he performed the first formal operation of nephrolithotomy.[1]

The preliminary incision for the operation is similar to that for all other extraperitoneal operations on the kidney: to repeat, the incision is about four inches long, extending from about three-fourths of an inch from the vertebral spines and carried parallel to the lower border of the twelfth rib and about half an inch below it. To determine the locality of the twelfth rib in patients with a deep layer of adipose tissue is by no means an easy task: as a safeguard against making the incision too high and thereby wounding the pleura, it is safest in all cases to count the ribs. If this preliminary incision be not large enough to give easy access to the kidney, a second incision may be made at either end of the first incision and at right angles to it. After cutting through the perirenal fat and exposing the kidney, the position of the calculus, whether in the pelvis of the kidney or enclosed in the renal tissue, often can be ascertained by passing the index finger over the surface of the kidney and the pelvis of the ureter, at the same time pressing down upon the kidney in order to detect calculi contained in the body of the organ. If the calculus cannot be detected by this means (and it happens quite often that calculi encysted within the kidney-substance elude the sense of touch even after the organ has been removed from the body), the kidney should be drawn well up in the wound, and an incision should be made through its substance just above the edge of the pelvis, where the tissue is thin. The cavity of the pelvis can now be explored with the finger, the safest and best means of detecting calculi either free in the pelvis or adherent to the calyces of the urinary tubules. The use of metal sounds is attended not only with considerable risk of puncturing the dilated end of the ureter and of unnecessarily lacerating the septa which lie between the openings of the calyces, but also there is the serious difficulty of manipulating the sound at the depth of the wound. It has been recommended as a result of their practice by eminent authorities to locate the calculus by puncturing the kidney in various places with a needle; this practice, however, has fallen somewhat into disuse. At any rate, whether or not the calculus be located by this means, the kidney should be opened and explored if it has seemed warrantable to expose it at all.

I have recently detected, with the vesical sound inserted through the lumbar wound, and have removed from the pelvis of the ureter, a calculus which lay quite beyond the reach of the finger. In another case the sound turned upward found a stone which had eluded digital exploration. Its use must, therefore, not be laid aside on account of the objections just mentioned, but it should always be employed, when used at all, with caution and gentleness. I have found the needle very disappointing as a searcher for stone; less so in seeking localized, tubercular,

[1] *Clin. Soc. Trans.*, vol. xiv.

cortical abscesses. In at least two cases it has misled operators by impinging upon calcareous grit.[1]—(J. W. W.)

The hemorrhage, which is mainly venous, can be usually controlled by means of plugging with sponges or gauze, but rarely does it prove sufficiently obstinate to necessitate the conversion of the operation into a nephrectomy. Tiffany suggests[2] that in order to determine the perviousness of the ureter some colored solution should be injected at the renal orifice, and then the urine withdrawn from the bladder to see if the fluid passes freely. The health of the opposite kidney can be determined if the exposed ureter is washed out, and then plugged so that no urine from the opened kidney passes into the bladder.

The less the perirenal fat is disturbed the better the chances for rapid healing.

The wound should be packed with iodoform gauze and a drainage-tube inserted behind the kidney to drain off the urine, which will probably escape from the kidney-wound for two or three days. It is often well to put the inner end of the tube directly into the kidney-wound and leave it there for twenty-four or forty-eight hours. This is advisable especially in cases where there has been much suppuration or where the bleeding of the line of operation was profuse.

In many cases after the operation a sinus leading down to the kidney persists for some months, and great caution should be observed in any attempt to probe it for any chance stray fragments of calculus. In one of Sir Joseph Lister's cases reported by Godlee[3] the colon was accidentally punctured in an attempt to dilate one of these renal sinuses. The chances of such an accident are, however, steadily diminishing, inasmuch as the complication which may occasion it is becoming more and more rare as the general management of the operation is perfected.

Thorndike[4] has collected 128 cases of nephrolithotomy, including both suppurative and non-suppurative cases, with 18 deaths—a mortality of 14 per cent. "Of these 18 deaths, 10 occurred in cases which had come to suppuration at the time of operation, 6 in cases where there was no suppuration, and in the other 2 this point was not mentioned in the report. On the other hand, the cases in which this operation has been performed before suppurative change has begun have done remarkably well, the percentage of deaths being less than 5, and Newman reports 42 cases with no death, while Legue reports 40 cases with but 2 deaths."

In uncomplicated cases the patient is usually able to be out of bed in about a week or ten days after the operation. The sooner the patient can be allowed to sit up the better, as the passage of urine through the natural channel is thus assisted by the force of gravity.

It is interesting to remark that when kidneys have been opened with the expectation of finding stone, but none has been discovered, relief from the symptoms which occasioned the mistake has been the rule rather than the exception, as was observed in reference to supposedly movable kidneys (see p. 473) which were not found at the time of operation. Mr. Reginald Harrison's remarks on this point are worthy of more attention than has been accorded them: "I could enumerate many

[1] *Bull. de Thérap.*, 1881, p. 343; *Trans. Phila. Co. Med. Soc.*, vol. x., 1889.
[2] *Trans. Am. Surg. Soc.*, 1889.
[3] *Practitioner*, vol. xxxix.
[4] *Bost. Med. and Surg. Journ.*, Dec. 1, 1892.

instances where I have urged and practised digital exploration of the kidney merely for the purpose of searching for the cause of painful symptoms which have resisted all other methods of treatment, both medical and surgical. I have never had cause to regret this; on the contrary, without, I believe a single exception, good has come out of it. It has not, however, been always clear how this benefit was obtained. Let me state two or three instances. In the summer of 1887, I saw at the Royal Infirmary, with Dr. Davidson, a stout, healthy married woman, about thirty-five years of age, who for over a year had been suffering from what appeared to be acute attacks of renal colic attended with considerable hæmaturia. Various kinds of treatment had been tried and were tried, but without avail, and she was anxious to submit to any operation that offered a prospect of relief. I thought she had stone in the kidney, and advised exploration. This was done by me, and in consequence of her stoutness I had to make a much longer incision than usual, as until I got my hand fairly within the parietal wound it was impossible even to touch the kidney with the tip of my finger. I was enabled to feel it thoroughly with the hand, and I also explored it with a needle in several places, but no stone could be found. I thought the organ was more movable than natural, and that this might possibly be the explanation. However, she made a rapid recovery, and has remained well since. I saw her a few weeks ago. I never knew a case where the symptoms, in their kind and undoubted severity, more closely resembled renal stone, yet I am satisfied there was none. I have now seen three cases of renal hæmaturia where the bleeding ceased after digital exploration, and where the kidney had been well poked about with the finger in the attempt to discover the presence of a stone which really had no existence.

"The last instance was in the case of a man whom I intended to explore in consequence of severe renal hæmaturia. Whilst he was under observation in the hospital, in spite of various styptics, he passed large quantities of blood, and it seemed to be increasing. As I was just leaving for America, I transferred the patient to my colleague, Mr. Rushton Parker, who, after watching him for some time, operated and explored the kidney, but without finding anything to explain the bleeding. However, so far the bleeding has ceased and the patient has been able to resume his work. Here, there can be no doubt, the hemorrhage was at once checked, though whether permanently so it is premature to say, as barely three months have elapsed since the operation.

"A middle-aged man was under my care last summer for right nephritic colic, which seemed, from some pieces of stone which he passed, to be due to them. He continued to suffer much in this way, in spite of various remedies, and I advised digital exploration of the kidney. This was done, and, in addition, I inserted a capillary trocar at one or two points, but nothing was found. He speedily recovered, and had no recurrence of the colic symptoms. It is difficult to offer a satisfactory explanation for results such as these. Similarly, in some cases of kidney exploration performed by Professor Annandale, he also found benefit follow. In the absence of any special reason he thought this might be due to the division of the nerve, which was in some way responsible for these perversions of sensation and function."

Suppurative Diseases.

Suppurative diseases of the kidney may involve only the renal pelvis or may include the whole kidney-structure with the pelvis. The simplest form of this disease is a *simple pyelitis*, in which the kidney remains healthy and the pelvis alone is the seat of inflammation. Simple pyelitis may be *catarrhal* or *purulent*, and may be acute or chronic.

The symptoms of calculous pyelitis are merged into those due to the presence of the stone, and have been sufficiently considered above.

The next grade of severity is where the pus formed in the pelvis is retained either by clogging of the mouth of the ureter by masses of pus or by the obliteration of the lumen from kinks or twists occurring farther down in the course of the ureter, or from the impaction of a stone; this condition is then known as *pyonephrosis*. A still further extension of the suppurative process to the substance of the kidney, termed *pyelo-nephritis*, is where the organ becomes converted into a mass of small separate abscesses or into one large suppurating sac. Suppuration may also exist in the substance itself of the kidney, without the pelvis or the ureter entering into the process; this form constitutes what is known as *suppurative nephritis* or *renal abscess*. Finally, suppuration may occur in the tissues surrounding the kidney and its capsule, and form a *perinephric abscess*.

These, then, comprise the different degrees and localities of suppurative disease in their simplest forms involving the kidney and its surroundings. The presence of a renal calculus may complicate any of them, and they may be rendered much more grave from their dependence upon some specific disease, such as tuberculosis or cancer of neighboring structures; or, when the disease is bilateral, the prognosis, as may be readily supposed, is much more unfavorable.

Catarrhal pyelitis is caused by stricture of the urethra when the urine is constantly forced back upon the ureter, not in sufficient quantity to dilate it permanently, but enough to cause a slight overstretching and congestion. The urine usually is partially retained, and is apt to become alkaline and irritating to the mucous membrane. In all the acute fevers the renal pelvis is likely to be congested, and a mild degree of pyelitis is set up, together with an acute nephritis due to the altered character and concentration of the urine. Certain drugs, such as turpentine, cantharides, copaiba, etc., are also said to excite pyelitis, of a mild degree, secondary to cystitis. Renal calculi are frequently associated with pyelitis, but are probably secondarily produced from the decomposing urine, containing pus and albumin, and are therefore more often the effect rather than the cause of pyelitis.

Traumatism is a not infrequent cause of a simple catarrhal pyelitis which may readily become suppurative; blows and contusions in the iliocostal region may be followed both by acute pain in the renal region and haematuria for a short time; apparently the patient recovers entirely, but, before long, pus in slight amount is noticed in the urine and there are occasional sharp attacks of pain, showing that a purulent pyelitis has been established. This may subside under simple rest in bed, mild diet, and bland liquids, or it may run a more or less enduring course for years, and terminate in pyonephrosis or pyelonephritis.

Purulent pyelitis is much more serious. It requires for its production two factors—pyogenic microbes and a suitable soil for their growth. The healthy mucous membrane of the bladder, ureters, and kidneys easily resists the attacks of micro-organisms. This has been shown experimentally, and the clinical facts are equally emphatic. Keyes[1] has recently summarized them as follows: "As early as 1873, Fels and Ritter, by inoculating the bladder of dogs, produced ammoniacal urine and cystitis, but only on condition of ligating the urethra. Upon loosening this ligature the bladder promptly resumed its condition of health. So Guyon, Albarran, Guiard, and many others, introducing pure cultures of micro-organisms into the healthy bladders of animals, fail to set up cystitis, unless to the microbic germ there be added other factors, such as ligating the urethra to produce forced retention or wounding the bladder. Certain micro-organisms have proved themselves more virulent than others, just as certain subjects are exceptionally susceptible; and Schnitzler claims that with the 'urobacillus liquefaciens septicus' he can produce cystitis without tying the urethra. This urobacillus is now believed to be identical with the bacterium coli communis; more evidence is therefore needed. Barlow has recently contributed some testimony on this point.

"But Guyon, Petersen, Albarran, and many others have repeatedly proved that retention, ligating the urethra, trauma—not one of these causes alone will produce cystitis, and that any one plus the proper germ will do it. Straus and Germont clearly proved that simple ligature of the ureter, aseptically performed, does not occasion inflammation of the kidney, but produces dilatation and atrophy; while Charcot and Gombault, with equal clearness, have demonstrated that septic ligation of the ureter does produce the suppurating kidney.

"That trauma prepares a soil for microbic infection is beautifully illustrated by Albarran. He showed that the blood might be a channel of infection by inoculating one ureter and ligating it below, then finding both kidneys implicated, as being spots 'minoris resistentia'—the ligated side because of congestion and of direct infection, the other on account of its hyperactivity from having had double work to do. Th Albarran injected his bacterium pyogenes directly into a blood-vessel a number of animals, and got plenty of embolic abscesses in every i stance, but found the kidneys free in all save one. To study the effe of injury plus germs, he therefore contused one kidney in a rabbit a injected a pure bouillon culture of bacterium pyogenes into its ear. T next day this kidney was already in commencing suppuration. He pr duced nephritis also by injecting the ureter (and ligating) with strepto coccus pyogenes, and with staphylococcus aureus as well. The soil hav ing been prepared by reason of the existence of urethral stricture, o hypertrophied prostate, of vesical or renal calculus, of any cause whic produces backward pressure and interferes with the free passage of urine from the kidneys to the urethral orifice, the micro-organisms may gain access to the kidneys in a variety of ways—by (1) propagation along the mucous surface by means of local damage to the deep urethral membrane (tubercle, cancer, stone, bruising violence, erotic excitement, gonorrhœa, gouty congestion, enlarged prostate, or spontaneously); (2) intro-

[1] *Amer. Journ. of the Med. Sci.*, June, 1894.

duction by the surgeon upon his instruments; (3) the bursting into the urinary tract of some extraneous focus of suppuration; (4) transmission through the unbroken tissues from a neighboring focus: it has been even alleged that the bacterium coli commune may get through from the rectum and do its work upon the mucous membrane of a bladder ready to receive it; (5) from descent from the blood downward through the kidney—but this, except the wedge-shaped pyæmic foci, is very uncommon, and, as in Couchard's suppurative nephritis occurring through a course of general infectious malady, the suppuration, commencing in the kidney, usually remains there and does not descend into the bladder." When these factors are added to the former, we have a condition that threatens to become of great gravity and often develops into either a pyelonephritis or a pyonephrosis (*q. v.*). Tilden Brown,[1] after a careful study of three cases of cystitis, pyelitis, and pyonephrosis, concludes that "the bacillus coli communis under certain circumstances becomes a pathogenic agent when it gains access to the kidney either by the blood or by the ureter. At the same time, we may infer that this bacillus can continue to live in the urinary tract without exciting symptoms or interfering in any manner with a condition of apparent health, unless a subsequent trauma be sustained by the mucous membrane of this tract."

The **symptoms** of pyelitis are pain in the loin of a deep-seated character, sometimes intermittent, sometimes with acute exacerbations. The pain is increased by pressure over the kidney both anteriorly and posteriorly. There is increased frequency of urination, and there is an excess of mucus in the urine, which is acid in reaction and also contains pus—not, however, in large amount—and epithelial cells which rapidly settle to the bottom of the glass. There may be also a slight degree of hæmaturia. In pyelitis due to tumors of the kidney or of the pelvis or to a calculus the hæmaturia is more profuse. There is usually some fever when the onset of the disease is sudden, and as suppuration advances it is attended by its usual symptoms.

In *ascending pyelitis*, due to extension from a cystitis, the symptoms of the cystitis are usually the more prominent. In the early stage an important aid to diagnosis is said to be obtained from a microscopical examination of the epithelial cells found in the urine, in order to distinguish between this disease and cystitis, but, as Newman has observed,[2] when suppuration and desquamation of the epithelium occur the cells soon lose their histological relationship, and, in all stages of degeneration are thrown off, so that the attempt to form a diagnosis of pyelitis from the separate loose cells contained in the urine is futile.

Treatment.—The removal, if possible, of the exciting cause is the first step in the treatment. Strictures of the urethra and obstructions to the outflow of urine, such as enlarged prostate, cystitis, vesical atony, etc., should be overcome. More than usual care, however, must be exercised in all surgical operations on the genito-urinary tract during a pyelitis, the risk of converting even a simple pyelitis into a pyelonephritis or "surgical kidney" being very great. The urinary tract should be rendered aseptic as far as possible by means of antiseptics administered internally, such as salol, boric acid, and the benzoates. Diuretin, a combination of theobromine and salicylate of soda, has

[1] *Journal of Cut. and Gen.-urin. Dis.*, April, 1895. [2] *Surg. Dis. of Kidney*, p. 205.

been asserted to be beneficial in a number of renal operations, as a prophylactic against urinary or urethral fever, if administered in ten-grain doses every four hours on the day of operation, and also every four hours for forty-eight hours after the operation. Subsequent experience has failed to confirm this assertion.

A *calculous pyelitis*, in the light of modern surgery, should be treated by nephrotomy and extraction of the calculus. In the more rare forms of pyelitis—namely, those due to the irritant action of certain drugs, and still more rarely those of apparently idiopathic origin—the treatment consists of rest in bed, hot fomentations to the affected side, bland drinks, and alkaline salts to reduce the irritating acidity of the urine. Opium may be necessary to relieve the pain.

PYONEPHROSIS results from the damming of the pus in a case of purulent pyelitis or from suppuration occurring in a case of hydronephrosis. The ureter becomes blocked either by a plug of pus and of blood-clot, or by a calculus, or by pressure from a tumor in a neighboring organ, which last is a common cause of obstruction; the pus distends the pelvis and a rapid degeneration of the renal structure ensues, much more rapid than in simple hydronephrosis. The pelvis may become deeply ulcerated, and perforation and escape of pus into the perirenal tissue occur. In most cases before rupture occurs the kidney becomes involved and a pyelonephritis is associated. The kidney substance becomes riddled with abscesses which coalesce and convert it into a lobulated sac filled with pus or purulent urine and blood; sometimes it contains inspissated pus, forming a doughy or chalky substance which entirely displaces the medullary and cortical portions of the kidney. An external fistulous opening in the loin is a favorable termination to pyonephrosis if left to itself; this is usually preceded by the formation of a perinephric abscess. The sac may, however, form adhesions with neighboring organs, and by ulceration implicate them in the process. Cases are on record in which the ulceration has penetrated the diaphragm and the pus has entered the lung, and the pyonephrosis emptied itself through the colon, the small intestine, the bladder, or the urethra after forming a perinephric abscess.

Symptoms.—In addition to the symptoms of a pyelitis, pyonephrosis is characterized at its onset by the acute symptoms aroused by the obstruction of the ureter. The pus contained in the urine will diminish in quantity, perhaps disappear entirely, if the obstruction is complete and only one kidney is affected, the disappearance of pus from the urine being accompanied by evidences of its retention in the renal pelvis. There is an accession of pain in the lumbar region, increased by pressure in front, but often relieved by pressure in the back. A characteristic tumor forms in the loin and may extend forward into the abdomen; it is either elastic and fluctuating or may be hard and doughy. Unless the tumor attains a very large size, no bulging in the ilio-costal space can be seen, and there may be tympany in the abdomen over the region of the kidney even when a large tumor has formed; this is owing to the colon being pushed forward, but there is, however, always dulness on percussion in the flank. The patient soon presents the constitutional symptoms of deep-seated suppuration—chills, high nocturnal temperature, anorexia, emaciation, pallor, and pinched features.

The **differential diagnosis** between pyonephrosis, hydronephrosis

and perinephric abscess is often difficult to establish. In hydronephrosis there is usually not so much fever, nor is there so much pain, and the symptoms come on more quietly. In perinephric abscess the pain is even more severe than in pyonephrosis, and there are often localized œdema and redness in the flank and extreme local tenderness; when fluctuation is present it is more superficial than in pyonephrosis or hydronephrosis. It is more than likely that there will be no pus in the urine. As will be of course noticed, these three diseases, pyonephrosis, perinephric abscess, and hydronephrosis, are all so closely allied that, as far as surgical treatment goes, the same preliminary steps are necessary in each. Absolute certainty is not, therefore, called for at the onset. After the preliminary incision is made the practitioner must be guided by what he can see or feel. The case is far different where differential diagnosis must be made between an aneurysm of the abdominal aorta, enlargement of the spleen or of the liver, or distended gall-bladder, sarcoma of the kidney, tumor of the suprarenal capsule, etc.: all these resemble pyonephrosis closely. Therefore it is that a true diagnosis is of the utmost importance, inasmuch as in some of these cases an attempt at nephrotomy might result most seriously.

Treatment.—When the nature of the obstruction which is holding back the pus in the ureter can be ascertained, the treatment should be first directed to the removal of this obstruction; strictures of the urethra, a frequent cause, should be dilated, tumors in the abdomen removed, etc. Massage over the course of the ureter will sometimes dislodge an obstruction, but it must be performed with delicate skill lest the dilated ureter be ruptured. Morris suggests[1] that when the obstruction is recent and probably consists of a small calculus or of a plug of pus and mucus, it may be displaced by allowing the patient to drink freely of hot liquids or by some jolting exercise, such as riding, etc.

Expectant treatment—viz. rest in bed, light diet, free movement of the bowels, hot applications locally, and anodynes—is only justifiable when the condition of the patient precludes any operation, or when the constitutional symptoms are mild and the ureter is not totally obstructed, but allows a certain amount of urine and pus to pass occasionally.

Unless there is a decided amelioration of symptoms in a week or so, operative interference should be resorted to; the continued suppuration is likely to produce serious amyloid changes in the opposite kidney, and the prognosis then becomes much more unfavorable in case nephrectomy has to be finally performed. It not infrequently happens, however, that the kidney rapidly atrophies and is obliterated, and the pus contained in its cavity becomes inspissated.

Aspiration of the pelvis and withdrawal of the pus gives only temporary relief, and eventually this operation has to be performed over and over again; it has therefore been pretty generally abandoned as a means of cure. It is nevertheless frequently employed to confirm the diagnosis. When the renal pelvis becomes dilated with pus and a distinct fluctuating tumor has formed, the operation of nephrotomy—that is, opening the kidney from a lumbar incision—is clearly indicated. The incision is made in exactly the same way as in lumbar nephrolithotomy, and the abscesses which have formed in the kidney and its

[1] *Surgical Diseases of Kidney*, 1885, p. 354.

pelvis are opened and drained. Careful search should be always made for calculi, since these are the most frequent causes of pyelitis and pyonephrosis. Frequently the kidney will be almost completely disorganized, and nephrectomy must be resorted to. It is, however, safest to defer this operation until the patient's system has recovered from the effects of the suppuration.

Nephrectomy is often necessary also in cases of obstinate fistulas which persist after nephrotomy, and where the patient is gradually weakening under the effects of prolonged suppuration. The acute febrile symptoms and pain of pyonephrosis soon subside after nephrotomy, but before long, unless the suppuration ceases, the patient begins to lose ground, and the only hope of relief lies in extirpation of the kidney.

Newman[1] gives an analysis of 49 cases of nephrotomy performed between the years 1870 and 1887 for suppurative disease without calculus, in which there were 13 deaths, or a mortality of 26.5 per cent. Guyon[2] gives the mortality of nephrotomy for pyonephrosis as 20 per cent. For nephrectomies performed between 1871 and 1887 for suppurative diseases without calculus he found in 54 cases 13 deaths—a mortality of 33.3 per cent. Among these 54 cases were 35 cases of pyonephrosis where nephrectomy was performed, ten times with fatal results, or a mortality of 28.5 per cent.

PYELONEPHRITIS is apt to follow rapidly upon any of the foregoing conditions when decomposing urine is retained in the pelvis; or it may be that the septic process extends from an existing pyelitis when there is no retention of urine; or, again, suppurative interstitial nephritis may originate primarily in the kidney and descend, involving the pelvis secondarily; this is the common course of a tubercular pyelonephritis, which begins insidiously with tubercular foci in the kidney. The exciting causes of pyelonephritis are the same as of pyelitis and pyonephrosis; it is merely a more extensive and more dangerous stage of pyelitis and an almost unavoidable complication of pyonephrosis. The name "surgical kidney" has been applied to this form of suppurative disease, owing to the fact that it was so frequently produced in the ante-antiseptic days of surgery by the use of instruments which we now know were dangerous. This term is a misnomer, and is an implied injustice to surgeons, who know too well that the so-called "surgical" kidney is often due to the ignorance of the patient and sometimes of the physician, both of whom neglect to secure relief at an early stage for the obstructive condition which almost invariably precedes the graver renal disease. In cases of ascending pyelonephritis the septic infection spreads up the ureter, involves the pelvis, then invades the calyces of the kidneys, and finally the micro-organisms make their way into the parenchyma of the kidney, invading the uriniferous tubules, blocking them up, and causing them to rupture, thus converting the organ into a mass of small abscesses or perhaps one large suppurating sac. The cortical and medullary portions become entirely disorganized, and there remains finally but a mere shell of the kidney.

The pathological appearance of the kidney in the early stages of

[1] *Surgical Diseases of the Kidney*, p. 235.

[2] *Annales des Maladies des organes Gen.-urin.*, Aug., 1888, p. 518.

pyelonephritis is, briefly, as follows: The cortex is thinned, and the capsule is adherent in patches to the surface and also to the renal tissue, and when it is stripped from the kidney numerous small abscesses are opened. These foci of suppuration vary in size from about one-tenth of an inch in diameter upward. The substance of the kidney is soft, swollen, and congested throughout to a greater or less extent. On section, pale yellow streaks, the distended straight tubules, may be seen running from the cortex to the pyramids, and between these streaks the renal substance seems to be perfectly healthy. The pelvis is deeply congested, spotted here and there with ecchymoses or possibly with ulcerations. The inflammatory process may extend down the ureter, but this is not usual. Instead of the small areas of suppuration in the renal substance, large abscesses may form and rupture into the surrounding tissues and produce perinephric abscesses. Microscopically, the straight tubules are seen to be dilated and distorted into irregular shapes, sometimes even pear-shaped or ovoid; they are filled with epithelial débris, pus, urinary salts, and micro-organisms. The veins likewise are distended with partially coagulated blood and pus, which is in marked distinction from a pyæmic process, wherein the blood-clot and pus-formation takes place within the arteries. The Malpighian bodies and convoluted portions of the tubules are uninfected in the process, but become obliterated and destroyed as the process of abscess-formation closes about them. The process of disseminated abscess-formation takes place in the intertubular spaces or in the tubules themselves according as the infection is introduced through the lymphatics or through the tubules and thence to the veins.

Symptoms.—The extent of the suppurative process and the disintegration of so important an organ as the kidney make pyelonephritis assume the character of a general pyæmia rather than a purely renal affection.

There is usually pain in the loins; the urine is dimished in quantity, and may be even entirely suppressed. When the disease is not preceded by cystitis, and when the urine is not retained in the pelvis until it decomposes, it is acid in reaction and contains pus and blood.

The patient is at first chilly and feverish; then follows prostration of a typhoid character. The pulse is rapid and weak, the tongue coated and dry; there are persistent vomiting, occasionally hiccough, and exhausting sweats. The countenance becomes pinched and the expression anxious; mental dulness, semi-consciousness, deepening into coma, and finally death follow. The disease is usually rapidly fatal, terminating in about ten days or two weeks. Some hope, however, always lies in the chance that the pus may be discharged externally or become dried up and hardened after the function of the kidney has been destroyed and the opposite organ has assumed double duty.

Treatment.—Pyelonephritis must be treated as a pyæmia—that is, by stimulation with alcohol or with quinine, by absolute rest in bed, and by meeting symptoms as they arise. To prevent ammoniacal fermentation of the urine in the bladder, Dickinson recommends an injection of fifteen drops of dilute nitric acid, ten grains of quinine, and ten ounces of water.[1]

In view of the great fatality of pyelonephritis it is impossible to

[1] *Renal and Urinary Aff.*, vol. iii. p. 656.

express too emphatically the necessity of asepsis even in as trivial an operation as catheterization when there is obstruction to the outflow of urine.

SUPPURATIVE NEPHRITIS, or *renal abscess*, is the formation of multiple abscesses or of a single large abscess in the substance of the kidney independent of disease of the ureter or pelvis.

The **causes** of renal abscess are traumatism, pyæmia, renal infection from cystitis, and tubercle; abscesses resulting from blows or contusions are rare. When they do occur the portion of the kidney which has been contused becomes suffused with blood, and the broken-down renal tissues, in the presence of microbic infection through the blood or the ureters, are rapidly converted into pus.

The **symptoms** are shock and prostration following the injury, together with pain in the lumbar region and hæmaturia for two or three days; then pyuria, accompanied by fever and symptoms of deep suppuration. Total suppression of urine may occur just before the symptoms of renal abscess manifest themselves. Rayer has observed this symptom in the cases reported by him.[1] It is sometimes rapidly fatal, although Dickinson, led to his inference by a single somewhat doubtful case,[2] suggests that it is possible for an abscess to become chronic, and opening into the pelvis continue to discharge for a long time.

The **treatment** is at first expectant and symptomatic, rest in bed, and careful attention to the constitutional condition. If the abscess can be clearly located, aspiration may be practised. In the presence of marked symptoms exploratory nephrotomy should be performed. Often, however, the symptoms and the exact location of the abscess are masked until the constitutional depression of the patient will not admit of an operation.

PYÆMIC or METASTATIC ABSCESSES in the kidney usually escape notice until the patient becomes a subject for the post-mortem table. The intensity of the general disease usually overshadows the clinical signs of renal abscess.

SUPPURATIVE NEPHRITIS may occur in the course of any of the infective fevers, traceable to microbic origin. The infective material is carried to the kidney by the blood, and abscesses form in the renal tissues as the result of septic embolism. Both kidneys are likely to be affected in pyæmia, and the abscesses are more often minute and multiple than large and single, and are more abundant in the cortical areas than elsewhere. A large single abscess, however, has been known to occur as the result of embolism in a large branch of the renal artery.

Treatment.—The treatment of suppurative nephritis occurring in pyæmia is embraced in that directed against the constitutional disturbance.

Irritant drugs, chief among which are cantharides, have been thought to be capable of producing an acute suppurative process in the kidney. Dickinson[3] quotes in this connection the case of a man one of whose kidneys was completely destroyed from the internal administration of tincture of cantharides for the relief of incontinence. In the light of our present knowledge this cannot have been the sole cause. It must

[1] *Mal. des Reins*, vol. i. p. 842.

[2] *Renal and Urinary Affections*, vol. iii. p. 632.

[3] *Op. cit.*, p. 35.

either have aggravated an original septic infection (as seems probable, the drug having been given for incontinence), or have further irritated a mucous membrane already on the verge of degenerative change and ready for microbic invasion, which then speedily occurred.

(For the description of tubercular abscess of the kidney see the general description of Renal Tuberculosis.)

PERINEPHRIC ABSCESS, or, as it is more commonly known, *perinephritic abscess*, is a suppurative process involving the perirenal fatty capsule and cellular tissue; it may originate in one of the three following ways:

1. Primarily—that is, when there is no suppuration in the kidney or adjacent parts. The exciting causes may be sudden chills, strains, or bruises in the lumbar region, or even direct septic traumatism. These primary abscesses may also occur in the course of the exanthemata and infective fevers. Primary or idiopathic perirenal abscesses are rare. Dickinson[1] quotes from the *Transactions of the College of Physicians, London*, for 1806, a case occurring after a long and chilling ride. The onset and course were rapid; death followed in two days. Both kidneys were found to be surrounded by inflamed and partially gangrenous tissue. In a second case, reported by the same author, a perinephric abscess, resulting from constant jarring in a long and rough sea-voyage, finally burrowed upward, and, opening into the left lung, discharged through one of the large bronchi. The patient suffered also from pulmonary tuberculosis, a serious element which of course added a graver share in the etiology than seems to have been attributed to it by the report. The extraordinary rapidity exhibited in the former case is evidence that there was some pre-existent disease.

2. A perinephric abscess may occur consecutively to suppuration within the kidney, either with or without a direct fistulous communication with the renal pelvis. This form results with probably the greatest frequency in cases of renal calculus. It is, in short, an extension of suppuration by contiguity or by continuity. It may also occur in cases of pyonephrosis, of hydatid disease, of renal tuberculosis, and of cancer, especially of the ascending colon.

3. The third manner in which perinephric abscess arises is by transmission from an organ or region more distant than the kidney, as, for instance, from a cystitis or from perityphlitis, from a metritis or from an inflammation of the gall-bladder, or from a general state of pyæmia, etc. The loose cellular tissue which surrounds the kidneys offers a favorable culture-field for any infective material which may be circulating in the blood-vessels or lymphatics; and perinephritis is not at all a rare complication with inflammation in adjoining or neighboring organs. It may be even produced by operations upon the testicle, the rectum, or the bladder in the region of the prostate when absolute asepsis cannot be maintained.

The typical and most favorable cause of a perinephric abscess is when the pus burrows in the direction of least resistance and the abscess opens and discharges in the loin. The abscess may burrow downward, however, following the course of the blood-vessels, and discharge upon the thigh, or it may penetrate the sacro-sciatic foramen and open in the

[1] *Renal and Urinary Affections*, vol. iii. p. 678, 679.

gluteal region, or, yet again, it may appear in the inguinal region, having pushed its way along the psoas muscle. The pus may also burrow upward and discharge into the pleural cavity, producing a pyo-pneumothorax. Rayer also reports a case of pyelonephritis producing perinephric abscess, which in turn produced a large abscess in the liver; the patient nevertheless showed no characteristic hepatic symptom except possibly an obstinate constipation.[1]

This tendency of perinephric abscesses to travel upward should never be forgotten. In many cases seen by the surgeon for the first time after they have become supradiaphragmatic the pulmonary symptoms and the existing empyema quite mask the original phenomena, and lead to disappointment in treatment, as the usual incision for the drainage of empyema would quite fail to drain the suppurating tract or cavity in the loin. The chance of the transfer of suppurative action from below to above the diaphragm is probably greater in perirenal inflammation than in any other. The superior portion of the kidney lies upon the diaphragm, the lower margin of which crosses the back of the kidney in a direction obliquely downward and outward. This relation of the diaphragm is also shown by the depression of the kidney which occurs on deep inspiration. Holden says it descends nearly half an inch. The pleura on the upper surface of the diaphragm is therefore in proximity to the upper posterior perinephric region, and readily becomes, from contiguity of structure, involved in the inflammation.

I have reported[2] a case in which this route was taken, and which had been operated on for the resulting empyema by a distinguished surgeon. Many such cases have been reported by others. In Bowditch's series of 10 cases of abscess of the perirenal region there were unequivocal auscultatory indications of pleuritic or pulmonary complications in 7, although in 4 of them the rational signs were extremely slight. In several recorded instances the pulmonary involvement has occurred so early, or the previous symptoms have been so vague and insidious or so inaccurately observed, that the empyema has been supposed to be the primary disease. In obscure cases it will often be found that a history of flexion of the thigh upon the pelvis, of pain in the loin, or at least of distinct lameness about the hip, will indicate the cause of the thoracic disease. Niemeyer has dwelt upon the value of the position of the thigh as evidence of perforation of the pelvis of the kidney into the connective tissue.

In one of Dr. Bowditch's cases we may find an excellent example of these symptoms in cases in which the patient comes under observation only in the later stages. He was called to see a young man who was supposed to be dying of phthisis, and who was expectorating large quantities of pus. There was complete dulness over the lower lobe of the right lung, with bronchial breathing and coarse râles. Dr. Bowditch was at once struck by a peculiarity of the man's attitude. He seemed sitting as on one gluteus, in order apparently to relieve the other side. A history of lameness, together with pain in the right loin of three months' duration, was elicited. The lumbar fold of that side was found obliterated. On this evidence an incision was practised in the loin, pus was reached, and the case made a good recovery.

Dr. Duffin calls attention to a case quoted by Dr. Dickinson in which

[1] *Mal. des Reins*, vol. i. p. 556.

[2] *British Med. Journ.*, May 3, 1890.

an abscess opening into the groin was traced, on post-mortem examination, along the tract of the psoas to the kidney, and adds that the great diagnostic importance of the symptom of flexion thus produced will appear if read in connection with another peculiarity of these abscesses —namely, their tendency to implicate either the pleura or lung, and by partially emptying themselves upward to cause empyema and pulmonary complications. The symptom of flexion was absent in this case, but the other symptoms, the tenderness, the localized pleurisy, followed by empyema, were quite in accord with the history of a large proportion, or even of a majority, of cases of perinephric abscess in which for any cause operation through the groin is delayed. It should never be forgotten in such cases that the thoracic complications are not only the most frequent, but also the most important, coming on in an insidious and latent manner; they should always be sought for, even when the symptoms point exclusively to the abdomen, because the fact of the existence of abnormal thoracic signs has an important bearing on the treatment and prognosis of every case of perinephric abscess. On the other hand, the thoracic symptoms may completely mask the renal. Dr. Bowditch in his report upon the ten cases already alluded to records the following additional cases: A boy of weak constitution and of a consumptive family was seized with severe pain in the right side of the abdomen, and at the same time a distinct prominence below the liver became manifest. Soon after the pain lessened a cough began. A month later there was dulness below the middle of the right lung; three weeks afterward a pint of pus was discharged by coughing, followed by a lessening of the tumor under the ribs. The empyema was tapped a little later and a small quantity of pus obtained. The patient died, and at the necropsy a cavity was found in the lower lobe of the lung, which communicated by an opening through the diaphragm with an abscess above and back of the kidney, and surrounding the upper half of this organ.

A man aged fifty, who had been suddenly seized with pain in the right hypochondrium, followed in two and a half months by cough and the expectoration of fetid pus, was found to have a perirenal abscess.

In another case of the same character pain in the right renal region was followed by lameness of the right hip, with flexion of the thigh, and three months later by cough and purulent expectoration. Opening the perinephric abscess was followed by immediate and permanent relief.

Dr. Bowditch makes the following remark in reference to these cases: "The chief complications in connection with, and in consequence of, an abscess below the diaphragm are often very latent in their progress, and really at times become the more important features of the case. They may be the cause of death, and they are certainly liable to produce long-continued wasting disease."

A few further examples of cases of this kind may serve to illustrate the interesting and important points involved. Trousseau long ago emphasized the importance of early operation. He said that though sometimes the result of perinephric inflammation is a partially encysted abscess—the abscess remaining limited to the perinephric layer of fat and showing no disposition to extension beyond the lumbar region—yet at other times the inflammation gains the cellular tissue, occasionally even passing that barrier and reaching the pleura or lung, ending there

in pleurisy or pneumonia, the pus sometimes penetrating even into the bronchial tubes. These, he added, are the terminations and complications which result from too long delaying surgical intervention. This has been observed by MM. Demarquay, Cusco, Cazalis, and Bernutz, and a case is reported by Rayer in which there was a vomica in the lung attributable to a perinephric abscess.

In a short analysis of 12 cases of perinephric abscess contained in *Schmidt's Jahrbucher* (1865) it is stated that 5 perforated the pleura.

Gull reported the case of a man aged thirty-six who died of pleuropneumonia, and in whom there was found at the necropsy an abscess within the capsule of the kidney, which organ was adherent to the diaphragm, the latter being much softened at one spot, though not perforated. Just above the softened spot the left lung was adherent and was in a state of gangrenous pneumonia. Dr. Owen Rees reports the case of a patient aged seventeen in whom a large abscess of the kidney had passed upward behind the diaphragm and caused pneumonia of the base of the left lung.

Dr. Barkely reports the case of a patient aged twenty-two in whom there was an abscess of the right kidney, with firm adhesions between the liver and the diaphragm, empyema and abscess of the same side.

Diagnosis.—Perinephric abscess is to be diagnosed from appendix abscess by the greater tenderness in the loin as compared with that in the anterior iliac region; by the radiation of the pain toward the vulva or scrotum, rather than toward the umbilicus or general abdomen; by the history, which will often reveal the source of infection, and which will be diagnostic when the abscess is secondary to pyonephrosis or pyelonephritis; and by the peculiar attitude and gait already alluded to. I have recently seen a case of acute calculous pyonephrosis in which the existence of tympany, constipation, vomiting, etc. with distinctly localized tenderness to pressure over McBurney's point, seemed to warrant the diagnosis of appendicitis, but an incision in the loin revealed an enormously distended renal pelvis which broke down under the finger. In a few hours this would have been a perinephric abscess, but the history would have been that of appendicitis.

Nephralgia and fecal impaction have been mistaken for perinephric abscess, but lack all the inflammatory and suppurative symptoms.

Caries of the spine should be revealed by the characteristic rigidity of the vertebral column, the tenderness over a particular region, the pain on concussion, the relief of pain on stretching the spine, and later by the kyphosis. But Gibney has recorded a case[1] in which a spinal brace was ordered for an abscess of the perinephric region.

Localization.—I have frequently found the scheme arranged by Roberts[2] on the basis of regional anatomy of value in practical work. He arbitrarily divides the perinephric cellular fatty tissue into six tracts —the upper, middle, and lower anterior and the upper, middle, and lower posterior. For reasons which depend on the nervous, vascular, and other relations of the region he classifies the possible localizing phenomena as follows:

All Anterior Regions.—Pain, tenderness, swelling, œdema, and pointing in front and side of abdomen.

[1] *Chicago Med. Journ. and Examiner*, June, 1880. [2] *Loc. cit.*

All Posterior Regions.—Pain, tenderness, swelling, œdema, and pointing in loin.

Upper Tracts.—Pleuritic friction, pleural effusion, empyema, expectoration of pus, dyspnœa, suprarenal involvement, solar-plexus involvement (on right side). Bilateral œdema of legs, jaundice, fatty stools, persistent vomiting, rapid emaciation, ascites.

Middle Tracts.—Albuminuria and casts; suprapubic, scrotal, or vulvar pain or anæsthesia; suppression of urine; uræmia, pus in the urine; œdema of scrotum or varicocele (especially on left side).

Lower Tracts.—Flexion of hip; pain or anæsthesia of front, inside, or outside of thigh; retraction of testicle; pain at knee; scrotal or vulvar pain or anæsthesia, without accompanying albuminuria; unilateral œdema of legs; abscess or sinus near Poupart's ligament; constipation (if left side); involvement of chyle receptacle (if right side).

Symptoms.—The onset and severity of the symptoms will be naturally influenced greatly by the cause of the perinephric abscess; for instance, an appendicitis, a typhilitis, a perityphlitis, or a cystitis which originates a perinephritis, may entirely mask the perirenal inflammation. The *constitutional* symptoms are in general similar to those which follow any deep-seated suppuration, such as, fever, rigors, loss of appetite, prostration, etc. Obstinate constipation sometimes results from pressure on the colon. The *local* symptoms are pain in the lumbar region, worse on motion and pressure, followed shortly by the appearance of a doughy swelling in the loin which gives indistinct fluctuation on palpation. Before this swelling can be positively demonstrated careful measurements of the girth of the lumbar regions must be made; these measurements will show a difference of one or two inches, the affected side being of course the greater. The skin over this swelling becomes waxy and œdematous and somewhat red. The pressure of the abscess upon the third and fourth lumbar nerves, whose branches supply the psoas, iliacus, and pectineus muscles, causes flexion of the thigh on the abdomen. Roberts[1] has called particular attention to this symptom as giving a very characteristic gait closely resembling the second stage of coxalgia; the body is bent forward, and the hand on the affected side is rested on the middle of the thigh as the patient walks. Flexion of the thigh indicates, he maintains, that the abscess is opposite the lower third of the kidney. I have frequently demonstrated the correctness of this statement. The pain is almost always referred to the thigh and to the knee. All motions of the thigh except extension may be free and painless.

The urine will probably show no characteristic pathological change unless the kidney is involved in the process. When the abscess is purely perinephric there will be no pus or blood in the urine unless the pressure of the abscess produces a passive hyperæmia and albuminuria.

Treatment.—In the early stage of perinephritis it may be possible to allay the symptoms by means of local depletion obtained by wet cups or by leeches, together with absolute rest, mild diet, and keeping the bowels freely opened. When suppuration has become established the region round the kidney should be opened and drained by means of a lumbar incision. It is best to use the finger instead of the knife to open

[1] *Am. Journ. Med. Sci.*, April, 1893.

up the abscess-cavity and break down any septa. The pus which escapes from these perinephric abscesses often has a fecal odor and arouses the suspicion of an intestinal communication. The fecal odor, however, is caused by the close proximity of the large intestine to the abscess, and does not necessarily indicate an intestinal fistula.

In cases of long duration and where the abscess is of large size the pressure may have caused marked atrophy of the kidney, or the kidney may be so much involved that nephrectomy is also indicated. It has been found to be the safest course in such cases to make two operations, and let the patient recover from the constitutional effects of the suppuration before submitting him to the additional strain of a nephrectomy.

Hydronephrosis.

Hydronephrosis is a condition of over-distention by fluid of the pelvis of the kidney, caused by obstruction of the normal outflow of urine through the ureter or through the urethra. It may be congenital or acquired, permanent or intermittent, unilateral or bilateral. There is usually a rapid atrophy of the kidney following the formation of a complete hydronephrosis, and a portion, if not all, of the ureter is involved in the dilatation according to the position and completeness of the obstruction to the flow of urine. The degree of dilatation depends, as Albarran and Legueu have stated,[1] upon the obstruction being complete or incomplete. If the obstruction be complete, rapid atrophy of the kidney ensues and secretion ceases, whereas if the obstruction be permeable to a small amount of urine, great dilatation is likely to take place; in such a condition hypertrophy of the parenchyma rather than atrophy is apt to be found.

The fluid in a hydronephrosis is usually urine somewhat modified and of almost neutral reaction, containing renal and pelvic epithelium and a slight amount of albumin. Morris, however, has recorded a case in which the fluid was composed wholly of water and sodium chloride, without a trace of urea or albumin or any other characteristic of urine.[2] Staples observes that "as long as any of the renal parenchyma is capable of work and serous transudation takes place, the normal urinary ingredients in the sac will be preserved and augmented; but when the secreting portion of the kidney is totally destroyed a fluid more or less seromucous in nature remains, which will exist undecomposed indefinitely if a ferment be prevented from entering.[3] Tying the ureter under thorough asepsis has been found to produce dilatation of the pelvis and atrophy of the kidney, but not pyonephrosis nor pyelonephrosis."

Congenital hydronephrosis, when bilateral, is rapidly fatal, the child seldom living longer than a few months; when it is unilateral, this affection may exist for a long time without causing any symptoms, and the kidney becomes completely atrophied; if the obstruction is incomplete, the cyst increases in size gradually until it reaches a comparatively enormous bulk. The causes of the congenital form of the disease are of course numerous: among them may be specified imperfor-

[1] *La Semaine médical*, Paris, Apr. 30, 1893.
[2] *Medico-Chirurgical Transactions*, vol. lix. p. 253.
[3] *Journ. of Am. Med. Ass'n.*, Apr. 12 and 19, 1884.

ate urethra or ureter; malposition of the ureter—namely, when it connects with the kidney or the bladder at an angle so acute that it readily becomes kinked or twisted; or, again, anomalous folds and reduplications of the mucous membrane at the vesical orifice, producing valves which more or less completely dam up the urine; congenital tumors of the bladder or of the ureters or of the neighboring organs. Among these congenital causes the condition of true floating kidney may also produce hydronephrosis by favoring the formation of acute bends in the ureter; this cause, however, is of the rarest. When the disease is congenital, the dilatation usually attains proportionally a much greater size than when the disease is acquired, even when the congenital obstruction is complete, owing to the fact that during intra-uterine life the kidneys secrete much more slowly than after birth, and, consequently, the occlusion does not produce an intrarenal pressure sufficient to arrest secretion until the delicate pelvis and ureteral tissue have become relaxed and overstretched.

Treatment is usually unavailing; when the condition is unilateral, however, and due to congenital tumor, the prognosis is somewhat more favorable, there being a possibility of removing the cause of obstruction by an early operation. When due to kinks or twists of the ureter or to a small impacted calculus, the sac may be emptied by manipulation through the abdominal walls or by tapping; but usually such procedures have to be repeated again and again, and are not unattended with a serious risk of rupturing the sac or of producing septic peritonitis. Newman [1] quotes Thornton as having "successfully operated upon a child aged seven years who had hydronephrosis from occlusion of the ureter."

ACQUIRED HYDRONEPHROSIS may be caused by a great variety likewise of conditions which produce an obstruction to the outflow of urine, such as stricture of the urethra, enlarged prostate, benign or malignant tumors of neighboring organs, movable kidney and displacement of other pelvic organs, cicatricial constriction of the ureter, renal calculi, tuberculosis of the bladder and of the ureter, and irritable bladder, producing frequent urination; this last condition or cause is noteworthy because of the apparent contradiction which it involves: *a priori*, it might be assumed that the more frequent the urination the less noticeable would be the effects of obstruction, but, in reality, the frequent act of micturition has a tendency constantly to close the vesico-ureteral outlets, producing backward pressure upon the pelvis of the kidney, and by the persistent strain may produce a hydronephrosis of great extent, but without very marked atrophy of the renal substance.

Injuries in the lumbar region may be mentioned as a somewhat common cause of hydronephrosis, albeit the dilatation of the pelvis or of the ureter may not develop for weeks, for months, or even for years after the injury; thus Croft reports a case [2] where the hydronephrosis developed seven weeks after the injury. His explanation is that the laceration of the hilus or of the ureter produced an inflammation which sealed up the ureter. After drawing off several pints of fluid at each of eight tappings the hydronephrosis was cured. This result was most probably effected by the total obliteration of the secreting substance of the kid-

[1] *Surgical Diseases of the Kidney*, 1888, p. 105. [2] *Clin. Soc. Trans.*, vol. xiv.

ney. In cases of hydronephrosis due to traumatism there is almost always a history of hæmaturia for some days following the injury; therefore it is also very probable that blood-clots may cause the obstruction of the ureter.

Out of 665 cases tabulated by Newman,[1] stricture of the urethra and enlarged prostate with hypertrophy of the bladder were found to be the cause of 195 bilateral and 39 unilateral cases of hydronephrosis; next in order of frequency came tumors of the pelvic organs, causing compression of the ureters; from this alone there were 143 bilateral and 41 unilateral cases. Renal calculi produced unilateral hydronephrosis more often than any other of the causes noted, 51 cases being due to them, while it was found to be the cause of only 17 cases of bilateral dilatation.

It not infrequently happens that in a certain number of cases observed at post-mortem examinations no cause can be discovered. Such cases are supposed to have been due to the too acute angle of entrance of the ureter into the pelvis, the ureter being compressed as soon as the pelvis becomes distended with urine. Nervous irritability of the ureter has also been offered as an explanation of this occurrence, the mere presence of the urine with its pressure causing a spasmodic contraction of the ureter sufficient to impede considerably, but not entirely, the outflow of urine.

Bland Sutton says[2] that "it is a curious fact that some of the largest hydronephroses, unilateral and bilateral, that have come under notice have been cases in which it was impossible to assign an adequate cause. The most remarkable example of this is the celebrated case of Mary Nix, aged twenty-three years. She died at Hampton-Poyle, near Oxford, with a large hydronephrosis containing fluid to the amount of thirty gallons, wine measure. The dissection of the body was made by Samuel Glass, with some learned gentlemen of the university." Mr. Sutton adds: "I have read the account very critically, and feel there is no doubt as to the renal origin of the hydronephrosis. Nothing was found to account for it."

Age seems to have no bearing whatever upon the etiology of this affection; it occurs in the unborn and it occurs in any of the other "seven ages" of man. The infrequency of stricture of the urethra in women is counterbalanced by the greater frequency of pelvic tumors, and thus hydronephrosis is found with almost equal frequency in men and women; there is, however, a slight preponderance of cases among females.

The right and left side are equally subject; thus out of 50 cases noted by Staples,[3] 24 occurred on the right side and 26 on the left.

The physical signs of hydronephrosis are usually not marked in their character. Unless the sac becomes greatly distended it does not give rise during life to a palpable tumor, and unless the patient is anæsthetized deep palpation cannot be tried on account of tenderness. When the tumor has reached a large size—that is, when it contains several pints of fluid—it may produce a noticeable bulging in the loin or in the anterior portion of the abdomen reaching from the loin toward the umbilicus. On percussion there is dulness in the loin between the ribs and the crest

[1] *Surgical Diseases of the Kidney*, p. 114.
[2] *Tumors, Innocent and Malignant*, London, 1893, p. 381.
[3] *Journ. Am. Med. Ass'n*, Apr. 12 and 19, 1884.

of the ilium, but there may be tympany anteriorly when the colon lies in front of the hydronephrotic tumor.

Symptoms.—The extent of the hydronephrosis, together with the fact that it may be bilateral, unilateral, or complete (which is where the outflow of the urine is entirely stopped), influences, of course, the character of the symptoms. There are frequently cases in which the lesion is unilateral and incomplete, and the disease runs its course and the patient dies of some intercurrent disease without suffering at all from the hydronephrosis. If the disease is bilateral and complete, rapid atrophy of both kidneys takes place, and fatal uræmia is the inevitable result; but when the urine is only partially stopped the disease may remain dormant, and only a slight degree of dilatation take place, not sufficient to be noticeable during life and not causing any symptoms. In the greater number of cases, however, when the surgeon is called in there is pain in the lumbar region and a painful swelling in the loin and abdomen; urination is frequent, but the urine is scanty. The urine may contain a little blood and some epithelial cells. Added to these there are symptoms of insufficient elimination, manifested by nausea, vomiting, fever, and, possibly, convulsions. The pain may be paroxysmal, and all the symptoms of renal calculi may be simulated. Clarke mentions such a case,[1] which was not due to an impacted calculus, but to a contraction of the ureter; after the removal of the ureter from the body it was found to be impervious unless stretched to its limit; any attempt to force water through it when relaxed caused it to shrivel and become kinked.

INTERMITTENT OR RELAPSING HYDRONEPHROSIS is a condition sometimes found wherein the tumor suddenly subsides and is emptied into the bladder. The obstruction in the ureter is overcome or relaxes, and the subsidence of the renal tumor is followed by the evacuation of a large quantity of urine from the bladder. Intermittent hydronephrosis is a rare form, and, according to Henry Morris,[2] seldom gives rise during life to a palpable tumor. It is caused by abnormal mobility of the kidney and consequent twists in the ureter; occasionally by renal calculi, which may cause a temporary valve-like obstruction of the ureteral outlet from the kidney, but which may be eventually either forced through the ureter or become dislodged when the renal pelvis becomes largely dilated. After the subsidence of the tumor the patient may be free from symptoms for months or even years, when, apparently without cause, the hydronephrosis recurs. Morris quotes a case reported by Hare[3] in which the intermitting hydronephrosis was due to congenital twists in the long axis of each ureter. In another case reported by Gintrac[4] the tumor was wont to subside suddenly by discharging into the colon, the subsidence being followed by copious watery stools. Staples[5] reports a case of intermitting hydronephrosis which he cured by puncturing it several times, but which had previously discharged spontaneously into the bladder. He supposes the obstruction to have been caused by spasmodic contraction of the ureter and subsequent partial invagination.

Bland Sutton[6] says: "It must be borne in mind that there may be

[1] *Lancet*, Oct. 31, 1891.
[2] *Medico-Chirurgical Trans.*, vol. lix.
[3] *Med. Times and Gaz.*, 1857.
[4] *Sydenham Soc. Bien. Retrospect.*, 1867–68, p. 175.
[5] *Op. cit.*
[6] *Op. cit.*, p. 383.

difficulty in some cases in deciding clinically between a very large hydronephrotic cyst and an ovarian or parovarian cyst, and it is well established that cysts of the ovary and parovarium sometimes rupture, and the fluid, escaping into the peritoneum, is absorbed into the circulation and rapidly excreted by the kidneys. Thus, profuse diuresis following upon the sudden disappearance or diminution of an abdominal tumor is as characteristic of rupture of an ovarian cyst as of an intermitting renal cyst.

"There can be little doubt that nearly all hydronephroses intermit, but the term 'intermitting hydronephrosis' is reserved for those examples in which great diminution, and in some instances temporary disappearance, of the swelling takes place.

"Exceptionally both kidneys when hydronephrotic may intermit alternately. Of this rare form I have had one case under my care; as the diagnosis was somewhat obscure, the tumors were explored through an abdominal incision. In the course of the proceeding the phenomenon of intermission was actually observed. The hydronephrosis diminished in size and the bladder slowly filled."

Terrier and Baudouin[1] collected 83 cases of intermittent hydronephrosis, and state that floating or movable kidney is the cause in the greatest number. They also draw attention to the fact that in very many cases the disease eventually becomes permanent owing to the inflammatory constrictions and adhesions.

Effects of Hydronephrosis upon the Kidney Structure.—Griffiths[2] has made a very careful study of the histological changes in the kidneys produced by hydronephrosis. His observations show that two distinct histological processes occur in the kidneys in hydronephrosis, the one being the direct result of pressure, and the changes so induced are limited to a thin layer of tissue immediately subjacent to the surface pressed; and the other being a general or interstitial change identical with that seen in chronic interstitial nephritis, due in part at least to the distention of the pelvis, which by compressing and stretching the renal vessels as they pass into the kidney interfere with nutrition of the whole organ. The changes induced by pressure occur in every case, and they may or may not be accompanied by the interstitial or general changes above referred to. The former—*i. e.* the changes due to direct pressure—are manifested in a thin layer of tissue below the surface pressed by proliferation of the connective-tissue cells in the intertubular connective tissue, so as to form in the early stages a more cellular structure; and simultaneously with that there occurs a progressive diminution in size and number of the renal tubules in that part. Later, the newly-formed connective tissue becomes more fibrous, and the vascularity of the part becomes reduced almost to a minimum. The diminution in vascularity of the tissue immediately subjacent to the surface pressed renders the nutrition of that part insufficient to maintain in activity and full vigor the highly specialized cells of the renal tubules; nevertheless, the nutrition is sufficient for the growth of the connective-tissue elements to fill the spaces that would otherwise be left after the disappearance of the tubules and their epithelial lining. The

[1] *Revue de Chirurgie*, Paris, Sept., Oct., Dec., 1891.
[2] *Trans. of the Path. Soc. of London*, 1889.

epithelial cells lining the tubules gradually diminish in size, become clear, and ultimately disappear entirely. All these changes are inseparably associated with one another. All previous writers, Virchow among the rest, have referred the disappearance of the medulla in cases of hydronephrosis to simple atrophy from the pressure of the accumulated urine in the pelvis, and, so far as Griffiths is aware, no one has described the histological changes associated with the disappearance of the renal structure. He found that the general or interstitial changes were usually absent in cases in which the body of the pelvis was not at all or only slightly dilated, and present in all cases where considerable or extreme dilatation of the body of the pelvis had occurred. The distention of the pelvis takes place mainly in a forward direction, that being the direction of least resistance. The pelvis, being placed behind the renal vessels where they enter the hilus of the kidney, as it distends pushes these vessels in front, and so stretches and flattens them. From this stretching and flattening of the renal vessels the circulation through the kidney is diminished, and in addition to this direct mechanical effect of the distended pelvis upon the renal vessels, there arises, especially in the later stages of hydronephrosis, a thickening of the intima, and even of the media, from the formation in them of fibrous connective tissue, contributing to a further diminution of the channels for the renal circulation. This thickening of the vessels, especially arteries, may be so great as to diminish the lumen to one-half or even less of the normal size, and occasionally thrombi form in these altered vessels. This diminution in the circulation of the kidney—brought about in at least two ways, viz. (1) by direct stretching and flattening of the renal vessels as they pass over the distended pelvis, and (2) by a narrowing of the lumen of the vessels by a kind of arteritis or endarteritis—is, he conceives, the chief cause of the general or interstitial changes in the hydronephrotic kidney.

The **treatment** of hydronephrosis consists of surgical measures only. No internal medication has the slightest effect, unless in the direction of antispasmodics in those cases which are suspected to be purely functional, or due, in other words, to spasmodic contraction of the ureter. The free exhibition of diuretics in order to increase the pressure of urine and thereby force the obstruction tends only to increase the distention of the diseased kidney, and to throw an extra amount of work upon the sound one, which already has to perform double duty. The surgical measures consist of—(*a*) massage and manipulation of the swelling; (*b*) aspiration, or tapping with a trocar and cannula; (*c*) nephrotomy; and (*d*) nephrectomy.

(*a*) *Massage and manipulation* of the swelling have been successful in a number of cases in dislodging the obstruction at the inception of hydronephrosis where the tumor was due unquestionably to an impacted calculus or to kinks in the ureter resulting from movable or floating kidney. Vigorous kneading or rough handling of the dilated pelvis is somewhat risky; there is always a chance of rupturing the sac into the peritoneal cavity or into the perirenal tissue and setting up a fatal peritonitis or perinephritis. When successful the manipulation of the tumor is followed by a free discharge of urine from the bladder and a total subsidence of the renal swelling; if the hydronephrosis be due to impacted

calculi, this subsidence may be permanent, or it may be only temporary if the obstruction be due to movable kidney or to the acute angle at which the ureter enters the pelvis.

If the cause of the dilatation is a stricture of the urethra, or an enlarged prostate, or an abdominal tumor, or a displaced pelvic organ pressing upon the ureter, the removal of the cause claims attention first. When, however, the obstruction lies in the ureter, then we must resort to direct operations upon the sac.

(*b*) *Aspiration* and withdrawal of the fluid is an excellent method when temporary relief is necessitated by the urgency of the symptoms of pressure from the distention of the abdomen. The fluid almost invariably accumulates again, and the aspiration must be repeated time after time. On the other hand, after emptying the sac twice or thrice the kidney-structure may become so atrophied that secretion ceases and the sac gradually disappears. Goodhart[1] reports just such a case, where, after aspirating three times and applying as much counter-pressure as possible over the affected kidney, the sac slowly diminished in size, and finally disappeared entirely. The operation is not free from the risk of septic infection of the sac and the development of pyonephrosis. Puncture with trocar and cannula is a much more hazardous operation, and should be discarded altogether. In the table of operations performed for hydronephrosis compiled by Staples,[2] out of 39 cases of puncture of the sac, 18 deaths occurred, 3 were improved, 10 cured without a resulting urinary fistula, and 8 were cured, but a fistula remained.

When paracentesis is performed on the right side, the needle should be inserted at a point two and a half inches behind a line perpendicular to the anterior superior spine of the ileum and midway between the crest of the ileum and the last rib. On the left side the needle should be inserted about an inch higher up.

(*c*) *Nephrotomy.*—When repeated aspirations have failed to give permanent relief the next resort is nephrotomy. After this operation there is great likelihood of developing a permanent urinary fistula, which, owing to the constant drip of urine, is apt to make life a burden. In a certain number of cases where the secreting substance of the kidney has been entirely consumed no fistula results and the sac rapidly shrivels. When such a condition can be ascertained beforehand, nephrotomy is unquestionably the best operation. Otherwise, sooner or later the patient returns to obtain relief from the annoying fistula. Nephrotomy may be performed through either a lateral abdominal or through a lumbar incision; the lumbar incision is the better; it not only avoids the risk attending the opening of the peritoneal cavity, but also facilitates the performance of nephrectomy in case that operation is deemed advisable after the kidney has been explored.

Out of 18 cases of nephrotomy performed for hydronephrosis noted by various authors, none proved fatal; 12 were performed through a lumbar incision, and 6 by the transperitoneal or abdominal method. Only in 6 cases is it mentioned whether or not a fistula remained. Bruce Clarke states that in more than 50 per cent. of cases a fistula is established.[3]

[1] *Lancet*, Dec. 6, 1890.

[2] *Journ. Amer. Med. Assoc.*, April 9 and 12, 1884.

[3] *Surgery of the Kidney*, 1886.

The operation of nephrotomy is exactly the same as that performed for nephro-lithotomy (which has been described under Renal Calculus), except that no calculus is extracted.

(*d*) *Nephrectomy.*—As a final resort it may be necessary to remove the whole sac and the fragment of kidney. Theoretically, this is a nephrectomy; practically, it is nothing other than the extirpation of a cyst. The method of operation of nephrectomy is determined by the size of the tumor. When the dilatation of the renal pelvis has reached a large size, the transperitoneal method is to be preferred, as it allows much freer access to the kidney, although attended with greater risk. In a series of 46 cases of nephrectomy performed for hydronephrosis and cystic disease collected by Newman[1] there are 19 deaths—a mortality of 41.3 per cent. Sixteen of these fatal results occurred in the 32 cases where the abdominal method had been practised; hence the transperitoneal method shows a mortality of 50 per cent., while the lumbar method shows a mortality of 21.42 per cent.

In the treatment of intermittent hydronephrosis dependent upon movable kidney the condition has been cured by stitching the kidney firmly in place, and thus keeping the ureter taut and free from twists or kinks.

Cysts of the Kidney.

In considering *the cysts of the kidney* it is convenient for the sake of classification to divide them into three groups—namely, (1) simple isolated cysts; (2) agglomerated cysts, or polycystic disease; and (3) hydatid cysts. The first two may be either congenital or acquired; the third is always acquired.

(1) *Simple isolated cysts* are caused by obstructions of the uriniferous tubules or by constriction around the neck of the capsule of Bowman, which envelops the Malpighian body. They may be either single or multiple, but are always distinctly separated from each other by a portion of normal kidney-structure. They contain a clear, straw-colored fluid, often highly albuminous and occasionally tinged with blood. They are usually small, but may attain a size sufficiently large to be recognized during life, and even to cause symptoms of pressure in neighboring organs. In the majority of cases, however, the presence of these simple serous cysts is not recognized until the kidney is removed at a post-mortem examination. When the cyst is of sufficient size to be palpable through the abdominal wall, it is often difficult to distinguish it from a hydronephrosis or a hydatid cyst. In this case, Legueu[2] advises aspiration, and if the fluid withdrawn is highly albuminous the likelihood is that there is a cyst and not a hydronephrosis; the fluid drawn from a hydatid cyst will usually be found to contain the hooklets, and furthermore the condition will usually be associated with cysts of a similar nature in other parts of the body.

(2) *Agglomerated Cysts, or Polycystic Disease.*—In this disease the whole kidney is converted into a mass of cysts closely packed together, some even merging into others; they vary in size from a walnut to a pea, and obliterate every semblance of renal tissue, albeit the general shape of the kidney is usually preserved. When the cysts are com-

[1] *Surgical Diseases of the Kidney*, p. 158. [2] *Chirurgie du Rein et de l'Urétère*, 1894.

paratively few, they are found principally in the intermediary zone between the cortex and the medulla, which is due to their having formed first in the irregular and spiral portions of the uriniferous tubules. Newman states[1] that plugs of colloid material may be frequently seen at the point of constriction; above this constriction the tubule is irregularly dilated into a chain of cysts. Minute cysts in the cortical layer are due, as has been mentioned above, to the dilatation within the capsule of Bowman.

The polycystic tendency may be a congenital defect in the kidney, and numerous small agglomerated cysts may be present for years without causing any untoward symptom, when, all of a sudden, the disease makes a rapid advance and spreads throughout the organ and terminates fatally. The disease, apparently latent, may become suddenly manifest after a contusion or an injury in the lumbar region. It is also frequently associated with interstitial nephritis, of which it is difficult to determine whether it is the cause or effect.

The **symptoms** are always most obscure and present no characteristic (unless it be that the kidney becomes so large as to be palpable) by which a trustworthy diagnosis can be made. Rapidly developing uræmia may be the first intimation of the disease, although it is usually preceded by symptoms of chronic Bright's disease—namely, attacks of hæmaturia, albuminous urine, and late in the disease granular casts, finally uræmia and death. The patient not uncommonly falls into a state of profound cachexia, and, according to Le Dentu,[2] in rare cases œdema round the ankles may be present from the beginning of the disease, and finally extend over the lower limbs.

Treatment.—The disease is not amenable to surgery; it is almost always bilateral, and even when unilateral the opposite kidney is diseased in nearly every case.

(3) *Hydatid Cysts.*—In this country and in Europe, except in certain parts of Germany, hydatid disease is rare; it occurs with much greater frequency in Australia and in Iceland than elsewhere. The kidney is, however, somewhat rarely attacked; out of 1856 cases of hydatid cysts collected from Davaine, Neisser, and Thomas, the kidney was the seat of disease in only 112; that is, in about 6 per cent. of all cases. Most commonly only one kidney is affected, and according to Le Dentu[3] it is the left kidney. There is apparently no particular portion of the kidney in which the hydatids form; they occur in the cortical or in the medullary layers, and also in the renal pelvis or just beneath the fibrous capsule. They occasionally attain a large size, 6 or 7 inches in diameter, especially when there is but one cyst. The large size of the cysts and their tendency to protrude into the abdominal cavity have in several instances led to their being diagnosed as ovarian. They contain a clear transparent fluid of low specific gravity, rarely albuminous unless after the cyst has been once punctured. As these cysts enlarge adhesions are formed to the surrounding viscera or possibly to the large blood-vessels; when left to itself the disease not infrequently terminates by the evacuation of the cyst either through the urinary tract or the intestines; in rare instances it may open into the stomach or the bronchi; perforation of

[1] *Surgical Diseases of the Kidney.* [2] *Affections Chir. des Reins et des Uretères*, p. 497.
[3] *Op. cit.*

the peritoneum and discharge into the abdominal cavity seldom if ever occur. The most common location of the opening is into the pelvis of the kidney and subsequent discharge *per urethram*. This spontaneous rupture by no means results in permanent cure, but, according to Le Dentu, rather tends to a fatal termination, from a general septicæmia starting either in the kidney or in the organ into which the cyst empties.

Symptoms.—The earliest symptoms are usually merely those of compression of the neighboring organs and the feeling of weight and discomfort caused by the tumor, which has grown to a large size without attracting attention. The cyst takes about eighteen months to two years to grow to a size sufficient to cause serious compression: it then forms a palpable and almost spherical tumor, usually somewhat movable, in the hypogastrium; it may be fluctuating or it may be tense and hard, giving a characteristic thrill or quiver when it is percussed sharply; this thrill is, however, rarely elicited in renal hydatids. It may not be of homogeneous consistence throughout; part may fluctuate and part may have a consistence and form like that of the kidney. When the cyst ruptures and pours its contents into the renal pelvis, symptoms are aroused closely resembling those caused by the passage of a renal calculus through the ureter.

After the daughter-cysts have passed through the ureter, then symptoms of vesical irritation begin, possibly with strangury and retention of urine, and finally the contents of the cyst, mingled with urine, at times purulent or sanguinolent, are expelled through the urethra. Hydronephrosis may result from a stoppage of the ureter by one of the small daughter-cysts. After this evacuation the symptoms of pressure are relieved, and in very rare cases a permanent cure results; in the majority of cases, however, the cyst continues to discharge for some time, and the patient gradually loses strength, and finally succumbs, in a condition of profound cachexia. In a case operated on by Lawson Tait the cyst was as "large as a man's head," and had existed for two years without causing any pain, the chief symptom being frequent urination.[1]

Treatment.—The treatment of hydatid cyst is entirely surgical; drugs have no influence upon the parasite; removal of the cyst or evacuation and drainage of its cavity is the only resort. There are four forms of operation which have been employed—namely: (*a*) Puncture, which may be either a withdrawal of the fluid and then closure, or the puncture may be followed by an injection of iodine. This method of puncture is chiefly used for diagnosis, albeit it may result in a permanent cure. (*b*) The open method, which includes puncture and drainage, and also incision of the cyst and excision of part of its wall, the edges of the wound in the cyst being then stitched to the edges of the abdominal wound and the cavity drained. (*c*) Incision and evacuation of the cyst, followed by application of carbolic solution, 1 in 20, to its interior, and then closure of the abdominal wound without drainage. Bond reports a case of hydatid of the liver which he treated in this manner with good success, and recommends it as a treatment for abdominal hydatids in general; he says that, besides the case which he so treated, two others have been reported in Australia, where the operation is much more in

[1] Martin: *Lancet*, Jan. 3, 1891.

vogue.[1] Gardner of Melbourne approves this method only if the cyst has been first anchored to the parietes by suture, so that reopening would be easy if drainage became necessary.[2] (*d*) Nephrectomy, either partial or complete, in some cases will be necessary, owing to the extensive obliteration of the kidney parenchyma. This operation is, however, contraindicated when extensive and firm adhesions have formed between the kidney and neighboring organs and the tumor extends in a marked degree toward the abdomen and is very movable. Partial nephrectomy has been accomplished successfully in several instances for other diseases than hydatid cysts, and is feasible in the latter case when the cyst is small, superficial, and single, and involves the kidney-structure only to a slight extent.

Le Dentu mentions that injections of bichloride of mercury, in 1 : 1000 solution, have, in the experience of some operators, met with success in the treatment of hydatids of the liver. The method as described by him consists of injecting into the emptied cyst one hundred to five hundred grammes of the solution, letting it stay there for about ten minutes, and then allowing it to run out or drawing it out by means of an aspirator.

Malignant Tumors of the Kidney.

The malignant tumors found in the kidney are, in the great majority of cases, either sarcomata or carcinomata. Colloid cancer has been occasionally found in the kidney in connection with a general systemic infection. Sarcoma is most often found in children under five years of age, while encephaloid cancer is usually found later in life, most frequently between the ages of fifty and seventy. Scirrhus and melanotic solid tumors are very rarely, if ever, found.

Sarcoma and carcinoma may attack the kidney primarily or secondarily, but as the secondary infection never becomes of clinical importance, and is seldom recognized during life, it is not worth while to consider it here. When the kidney is affected primarily, however, secondary deposits are very apt to form elsewhere in the body, and it is interesting to note the verification of this fact from a table arranged by Roberts,[3] where secondary deposits existed elsewhere in 31 out of 51 cases; in the remaining 20 cases all other organs were absolutely free from deposits. In the neighborhood of the kidney the glands were affected in 15 cases, the liver and lungs each in 14 cases, the suprarenal capsules in 4, the omentum, the heart, and vertebræ each in 3, the costal surface of pleura in 1, and, strangest of all, the uterus, penis, and testicle were affected in only 1 case each. This last item is very noteworthy when the close lymphatic connection is considered which exists between these organs and the kidney.

Encephaloid cancer always starts in the cortical substance, and first attacks the epithelial lining of the uriniferous tubules, and then gradually spreads to the connective tissue in the pyramids. In cases of primary cancer of the kidney only one organ is affected, but when the deposits are secondary to cancer elsewhere both kidneys will be affected.

[1] *Brit. Med. Journ.*, Jan. 26, 1895. [2] *Intercol. Quarterly*, June to Aug., 1894.
[3] *On Urinary and Renal Diseases*, 4th ed., 1885, p. 579.

In children as well as in adults primary cancer of the kidney may attain a comparatively enormous size; but of what size soever, it is usually, when uniformly infiltrated, distinctly reniform, although the surface may be nodulated and irregular and of firm, but not hard, consistence. Adult males are affected much more frequently than females.

Symptoms.—The cardinal symptoms of cancer of the kidney are the presence of a comparatively painless tumor in the hypochondriac region and the presence of blood in the urine. The tumor is firmly fixed to the posterior abdominal wall, the small intestines are pushed to one side, and the transverse colon lies across the front of the tumor, which may be either uniform in consistence or may give the feeling of fluctuation in portions of its surface. It is usually felt quite readily under bimanual manipulation if the abdominal walls are thoroughly relaxed when the patient is anæsthetized.

The *hæmaturia* of cancer is characterized by profusion and by decided intermittence. It may come on apparently without cause, and be so profuse as to endanger life; then the urine will clear again, and in a few days or weeks another attack of hæmaturia begins, or the first attack may be the last. The intermittence is probably due to occasional occlusion of the ureter by clots or even by fragments of the growth. When it ceases entirely, it is probable that the tumor has encroached upon the ureter and occluded it permanently. Quite often the hæmaturia is brought on by some slight strain or bruise, and then, when the attention is drawn to the kidneys, the presence of the tumor is first recognized, and its origin is erroneously attributed to the injury. In children under seven years hæmaturia is very significant of renal sarcoma.

Pain is by no means a marked symptom; in many cases the disease runs its course absolutely painlessly. But when pain is present, it is in some cases rather an annoyance from the weight and dragging of the tumor than the sharp and excruciating pain often attendant on renal disease. In other cases the pain is severe and radiates down the thighs or into the penis and testicles; the testicle, however, is never retracted.

General gastric and intestinal disturbances are apt to occur at an advanced stage of this disease, owing to the pressure from the tumor; and from the same cause the legs may become œdematous, and thence the swelling becomes general, until in the last stage of the disease anasarca may develop. Uræmia apparently never occurs, the one healthy kidney being able to assume the duty of both.

The **prognosis** is always grave. After the disease has once set in the average length of life is in children from ten weeks to one year; in adults it is about two and a half years.

Treatment.—The treatment of malignant tumors of the kidney in the great majority of cases can be only palliative, meeting symptoms as they arise. Occasionally cases are reported of successful and permanent removal of these growths, but success is the exception, and permanence means merely a certain period of exemption, supposed to mean cure when its exceeds two or three years. When the tumor is recognizable from the exterior, it has already gone too far to expect that removal of the kidney will remove at the same time all the scattered deposits of the disease, which almost inevitably will soon spring into activity.

Abbe[1] says that the question of the possibility of the cure of sarcoma stands side by side with that of cancer, and as yet statistics show that only a few cases have gone beyond the three-year limit; one survived five years. Barth of Marburg reports, that, to June 8, 1892, he had collected statistics of 100 nephrectomies for malignant disease, the largest list yet gathered, wherein 42 died from operation, 20 died from metastases, and 38 were cured. From what has been just said it is to be feared that insufficient time has thus far (1895) elapsed wherein to decide the permanence of these "cures."

Sigrist collected 64, with 32 deaths from operation; 9 went a year and a half and had recurrence; 5 went beyond two years; and 1 continued well at four years.

The advisability of an operation is distinct from the possibility of cure. In the patient there is the inspiration of hope; in the surgeon, the praiseworthy ambition of disproving the discouraging statistics by new and more skilful methods.

Tuberculosis of the Kidney.

Tuberculous affections of the kidneys, like tuberculous disease in any organ or tissue, may run an acute or a chronic course.

Of the *acute*, or so-called *miliary*, form but little need be said, as it is never manifested clinically by any symptoms peculiar to itself. Some authors, indeed, do not make any distinction between these two forms, but consider one merely as the beginning of the other. Miliary tuberculosis of the kidney is almost invariably secondary to tuberculosis in other parts of the body, and whether it is primary or secondary it is, without exception, associated with deposits elsewhere. It is found more often than the chronic form (the "scrofulous kidney" of the older writers), and it is almost universally bilateral. Childhood and adolescence seem to be the ages most likely to be afflicted with miliary tuberculosis; in childhood, however, it occurs more frequently up to about the tenth year of age. A slightly larger proportion of males than of females is affected.

There is considerable difference of opinion as to the relation of renal tuberculosis to tubercular disease of other parts of the genito-urinary tract. (See section on Vesical Tuberculosis.) Bryson says[2] that of 174 cases observed by him which were positive examples of tubercular disease of the urinary organs, only 18 gave unmistakable evidence of renal involvement. He adds: "Neither in my notes nor within my recollection is there a single case where the disease was primary for the body in the kidneys, and I cannot elicit from these any figures as to the relative frequency of the primary infection of these glands in the uro-genital cycle. In a majority of the cases of renal tuberculosis the bladder gave the first clinical signs of mischief, and without any exception the lower urinary, and in males frequently the genital, organs were distinctly involved when first seen by me; but in a certain proportion of the cases the middle urinary passages were infected in a manner to fully justify the belief that the disease came to them from above—*e. g.* in those striking cases of surface-infection of the vesical outlet, the trigone, and ureteral ori-

[1] *Ann. of Surg.*, Jan., 1894. [2] *Journ. of Cut. and Gen.-urin. Dis.*, Nov., 1894.

fices, which are seen conjoined with renal tuberculosis, and which, under observation, glide steadily into unmistakable vesical tuberculosis, often spurred into activity by injudicious instrumentation. So that from the clinical, no less than from the pathological and etiological, points of view one must concede, for the uro-genitalia, a primary renal infection.

"How long the disease remains in the kidneys before infecting the lower urinary passages is of surgical interest chiefly in connection with the possibility of forestalling its spread by an operative procedure."

Pathology.—The miliary tubercles originate as little millet-seed granulations (whence the name) clustering around the terminal branches of the arterioles as they spread through the cortical substance. These small nodules soon encroach on the connective and vascular tissues and crowd aside the uriniferous tubules. The process then tends to extend along the pyramids, and gradually into the mucous and submucous tissue of the renal pelvis and the ureter; hence it has a pronounced tendency to involve the seminal vesicles, the prostate, and the testicles.

Prognosis.—Since the disease is seldom if ever recognized during life, and since it is practically never a primary disease, it is impossible to prognosticate the length of time a case may run before a fatal termination; but, owing to both the local conditions and the presence of disease elsewhere, the course of the case is seldom a prolonged one. The prognosis as to duration of life will therefore always depend upon the degree of involvement of the other portions of the body in which the disease is primary.

Symptoms.—There are no symptoms produced by this disease which can in any way definitely indicate the kidneys as the seat of these miliary tubercles, unless it be the presence of the tubercle bacilli in the urine, and these cannot invariably be found even when the disease is well advanced.

Treatment must be directed to the general condition of the patient, and follow the general line of treatment of all tuberculous cases.

Chronic renal tuberculosis (*scrofulous kidney, strumous pyelitis, scrofulous pyelonephritis*) occurs once where miliary tuberculosis occurs twice. It may be a primary disease in the kidney, but it is almost always associated with deposits of the disease elsewhere. It is as often bilateral as unilateral, and is a disease of adolescence and middle age rather than of childhood.

The process in this form of tubercular kidney begins in the apices of the papillæ by the formation of a caseous mass, which softens and infiltrates the tissues bordering on it, and so gradually creeps deep into the substance of the kidney. Infecting particles are simultaneously carried by the lymphatics and blood-vessels to areas at some distance from the primary focus. These new foci break down and form cavities in the renal substance, which enlarge and may rupture into the renal pelvis. This process advances until the whole kidney is converted into one or more large cavities. This same result is brought about by the blocking of the ureter either with a mass of pus and renal débris or by the thickening and ulceration which accompany the advance of the disease, thus causing a tubercular pyonephrosis.

Where only one kidney is affected the process ends in the conversion of that kidney into an atrophied putty-like mass; the pyonephrosis

dries up, and in the cavities there remains this tough substance containing cholesterin and oftentimes calcareous nodules, which during operation may lead to a mistaken diagnosis of stone.

Symptoms.—In the early stage of the disease the constitutional and local symptoms are not marked. There is usually pain in the lumbar region as soon as the disease becomes pronounced; it is of an aching character, occasionally paroxysmal, and reflected down the thighs and into the penis and testicle, simulating renal colic in all but the excruciating character of the pain and in the retraction of the testicle, which, it asserted, never occurs in renal tuberculosis. Soon after the onset of pain a tumor may be noticed in the loin, often extending forward into the abdomen, and at times, when situated on the left side, pushing the spleen in front of it; it is dull on percussion, and may be distinctly fluctuating, especially in the lumbar region; it is tender on pressure, and may be slightly irregular and nodulated on the surface. If the abdominal walls are thin, the thickened and indurated ureters may be occasionally palpable.

In the early stage of the disease the urine may be perfectly normal, or it may be excessive in quantity owing to the irritation of the excretory structure of the kidney. Later the urine becomes albuminous, alkaline or acid, and contains a slight amount of blood; also a considerable quantity of pus and débris of renal tissue. It is thick and cloudy when albuminous, but rarely contains tube-casts.

Hæmaturia is never profuse, but pyuria is constant when the ureter has not been occluded—an important feature in the differential diagnosis between renal tuberculosis and calculous pyelitis; in the latter hæmaturia is often profuse and pyuria intermittent.

Abnormal frequency of urination is due not alone to the irritation of the kidney, but frequently to the irritation of the bladder caused by the septic material continually poured into it, and finally by secondary infection, with the formation of tubercles on the mucous membrane. The first portion of the bladder to become involved is the trigone, probably owing to the fact that it is there that the ureters empty.

When the case is advanced there is likely to be high fever of a hectic type, a small, weak, and rapid pulse, and, occasionally, nausea and vomiting.

Diagnosis.—When no tumor can be felt in the loin and no tubercular débris is passed with the urine, it is almost impossible to differentiate clinically this disease and calculous pyelitis. The slight hæmaturia and the persistence of the pyuria are possibly here the only guiding symptoms.

Fenwick has tabulated as follows the history and symptoms which he regards as characteristic of the early stages of primary renal tuberculosis (*i. e.* appearing in the kidney before any other portion of the genito-urinary system) and nephrolithiasis respectively:

"TUBERCLE. *Family history* of phthisis or cancer. Age between twenty and forty. *Personal history:* Perhaps tuberculous bones, joint or gland disease; very rarely any previous urinary symptoms. *Symptoms*, onset: Polyuria of a murky type (the frequency of micturition being due to the quantity passed, not to irritation), vague lumbar pain, or a sudden chill, and severe pain in one kidney, but rarely colic. Some

frequency of micturition in the early stages at night from irritation of acrid urine. *Colics* appear later, are usually less severe, are more easily under the control of drugs, do not usually retract the testicle, and are preceded by rose-red blood if they are induced by ulceration and not blockage. *Hæmaturia:* Slight in amount, more or less persistent, uninfluenced by rest. *Urine:* Cloudy at the outset from admixture of mucus and pus. Acid, low specific gravity. Light-colored, depositing a thin layer of pus with streaks of blood, débris of connective tissue. Small clumps of caseous material. Albumin appears early. Tubercle bacillus found, but with difficulty and after much search, in acid urine. Inoculation of urine deposit into animals (Rovsing, Jacobson). *General condition:* Patient ailing, 'never feels well,' is anæmic, easily tired; no loss of appetite.

"STONE.—*Family history:* Negative, or of gout or gravel. Age about forty. *Personal history:* Negative, except perhaps the passage of gravel; of a 'weak' loin; of testicular neuralgia or 'sciatica.' *Symptoms*, onset: Vague lumbar aching or a sudden colic. Frequency of micturition, due to irritation; small quantities passed often, and in day—not at night—relieved by rest. *Colics:* More or less severe according to composition and size of stone, followed by blood. *Hæmaturia:* Intimately mixed; much more marked than in tubercle; dependent on exercise. *Urine:* Clear at outset, containing evidences of calculus in the shape of crystals. Acid, normal specific gravity. Pus later in course of case, then only forming a deposit when pyelitis has been induced. *General conditon:* Patient may enjoy first-rate health between colics."

Demonstration of the tubercle bacilli in the urine is usually, though not always, possible, but whenever there is a suspicion of tuberculous disease bacteriological examinations should be untiringly kept up. To examine a specimen of urinary sediment for tubercle bacilli it must be thinly smeared upon a cover-glass and dried, and then floated, film-side down, on a solution of aniline magenta or gentian violet. When quite deeply stained the cover-glass is rinsed in a 25 per cent. solution of nitric acid to decolorize everything but the bacilli. The acid is then washed off in distilled water and the slide again floated, film-side downward, in a solution of methylene blue, in order to counter-stain the tissues. The bacilli will now appear red in a blue field.

Prognosis is always most unfavorable, especially if both kidneys are affected. The range of duration is from a few months to four years.

Treatment.—As a general rule, the treatment can be little more than palliative,—the administration of anodynes where pain is severe, and general hygienic treatment for constitutional symptoms. Where perinephric abscesses form, nephrotomy often affords long-continued relief, and, in a number of cases, the opening of a tubercular cavity in the kidney, followed by thorough washing out and drainage, has afforded permanent relief. When the abscess could be opened directly through the parenchyma of the kidney, and did not encroach upon the ureter, I have never failed to obtain by these means a long period of relief, sometimes so long as to be permanent. Such a result, however, can be hoped for only when the process is limited to one kidney.

Nephrectomy is justifiable when there is every reason to believe that

the other kidney is perfectly sound and capable of standing the strain, and when the kidney is the only organ or tissue affected with tubercle. When the disease has existed for some time in the kidney, and when by renal examination and by cystoscopy the seminal vesicles, the prostate, the bladder, and the opposite kidney are found to be healthy, there is every reason to suppose that the disease is limited to one kidney, as it is to these organs that the disease first invariably spreads. Nephrectomy under such conditions offers the best chance of cure.

Surgical Diseases of the Ureters.

The inaccessible position of the ureters in part of their course places a decided limit to the surgical intervention which may be applied to the several lesions to which they are subject. They are comparatively seldom the seat of a primary disease which needs surgery, but the range of operation has become greatly enlarged of late years, owing mainly to the labors of Cabot, Fenger, and Albarran, whose excellent articles form the basis of this section.

Anatomy.—The ureter is a cylindrical muscular canal, with a rather uniform diameter of 3 to 4 mm. throughout its entire extent from the pelvis of the kidney to the bladder. It varies in length from 10 to 13½ inches, and never exceeds 15 inches.

Its course is straight or slightly curved as it passes down from the kidney, and its direction is somewhat oblique toward the median line. The curve described is sigmoid; the pelvic portion is strongly curved, almost the arc of a circle, with its convexity directed toward the lateral wall of the pelvis, until it finally reaches the neck of the bladder, the wall of which it penetrates so obliquely that it runs for half or three-quarters of an inch between the muscular and mucous coats. In the male it crosses the vas deferens on the posterior wall of the bladder; in woman it crosses the cervix and enters the bladder at a point midway between the meatus urinarius and the cervix.

The canal is not absolutely uniform in calibre throughout its entire course; in normal subjects it is narrowed in three places—namely, (*a*) at a point between one and a half inches from the pelvis of the kidney; (*b*) at the junction of the pelvic and vesical portions; and (*c*) at the place where it crosses the iliac artery, found in three out of five subjects. These localities correspond with the places where small stones from the kidney have been found to be arrested.

The relation of the ureter to the peritoneum is a matter of great surgical importance, and has been especially studied by Cabot, who says that the fact that the ureter is adherent to the peritoneum, and always separates with it as it is stripped up from the parts behind, will greatly simplify the search for the canal when operation upon it is contemplated. He adds: "The reason of this adhesion of the ureter to the peritoneum may be seen upon microscopical sections across a ureter separated with its peritoneum. It will be found that the ureter is more or less closely bound to the under surface of the peritoneum by fibrous bands, and thus this intimate connection of the ureter to the membrane over it is explained. Moreover, the relation of the ureter to that part of the peritoneum which becomes adherent to the spine is, within a slight range

of variation, pretty constant, the ureter lying just outside the line of adhesion; so that if the surgeon has stripped up the peritoneum and come down to the point where it refuses to strip readily from the spinal column, he will find the ureter upon the stripped-up peritoneum at a short distance outside this point. On the left side the distance from the adherent point to the ureter is from half an inch to an inch, while on the right side it is somewhat greater, owing to the ureter being displaced to the outside by the interposition of the vena cava between it and the spine."

The chief lesions demanding operative interference are wounds and lacerations, stricture, impaction of foreign bodies, calculi, and fistulous openings.

Wounds of the ureters alone are of very rare occurrence, except wounds accidentally made during operations for the removal of large ovarian or uterine tumors: the case of the archbishop of Paris, which is frequently cited, seems to be the only recorded case of gunshot wound of the ureter without implication of the kidney, and, inasmuch as the victim lived only a few hours in consequence of other severe injuries, our knowledge of the symptoms and diagnosis of this form of injury must remain extremely imperfect.

Le Dentu[1] quotes two cases of penetrating wounds of the ureter, one reported by Le Fort,[2] the other observed by Demons.[3]

Theoretically, wounds of the ureters should be treated on the same principle as penetrating wounds of the kidney, except that in the case of total transverse severance it would probably be safer to attempt first to find the severed end of the ureter and bring it out into the wound in order to establish a urinary fistula, and so save the kidney if the opposite organ should happen to be unsound. Lateral anastomosis of the two cut ends of the ureters is recommended by Fenger,[4] but it is evident that in the case of penetrating wounds this probably would be a most difficult operation: this, however, is no valid argument against it. In all cases of suspected ureteral rupture the wound should be carefully drained in order to limit the infiltration of urine. Subparietal ruptures of the ureter have been reported a number of times. Among others, Le Dentu[5] has collected 11 cases.

The **symptoms** of ruptured ureter are the same as those of ruptured kidney, except that they are of a much milder character.

Suture of the ureter in case of subparietal rupture has not yet been attempted, and it is doubtful if it could be performed, inasmuch as a diagnosis of the rupture is only possible when a tumor forms from the extravasated urine, and, as this does not usually take place until several days or weeks after the injury, the tissues round the ruptured ends of the ureter would be much altered in character, and thereby make the detection of the rupture difficult; and, moreover, the ureters themselves probably would be in no condition for healthy union.

In subparietal ruptures of the ureters the indications for nephrectomy are the same as in subparietal wounds of the kidney, except that the question of hemorrhage would probably not have to be considered. In

[1] *Aff. chir. des Reins des Uretères, etc.*, p. 762. [2] *Bull. de l' Acad. de Méd.*, 9th Nov., 1880.
[3] *Thèsis de Biar sur les Fistules de l' Uretère*, Bordeaux, 1885.
[4] *Ann. of Surgery*, Sept., 1894. [5] *Aff. chir. des Reins des Uretères, etc.*

the event of the formation of a tumor from the extravasating urine, the kidney must be cut down upon without delay, and, if the strength of the patient justifies, the kidney must be at once removed, otherwise an attempt must be made to establish a urinary fistula.

Strictures of the ureter, caused by traumatism either external or internal—that is, either by blows or by the passage of a calculus—when situated in the upper abdominal portion are amenable to surgical treatment in one of three ways: 1. Dilatation by means of a bougie. Alsbery[1] has reported a case thus summarized by Fenger:[2] "Lumbar nephrotomy in a case of left hydronephrosis. For ten days all urine passed through fistula, from which it was concluded that the other kidney was defective in function. Ureter successfully dilated from wound by thin bougies. After several days urine passed through bladder. Some months later fistula closed. Hydronephrosis did not reappear." 2. Longitudinal incision, lately described by Fenger, whereof the procedure, briefly stated, is as follows: The stricture is divided longitudinally after opening the ureter above or below, and the ends of the longitudinal incision are brought together by folding the ureter upon itself; the remainder of the wound is then united by sutures passed through the outer and middle coats.[3] 3. Resection of a portion of the ureter and implantation of the lower end into the pelvis above the stricture.

Foreign bodies found in the ureter are, mainly, renal calculi, which have become lodged during the passage down to the bladder; one or two instances of emphatically extraneous bodies have been recorded which had reached the ureter by ulcerating their way from the intestine. Calculi may lodge at the ends of the ureter, either where it merges into the renal pelvis or where it enters through the coats of the bladder, and are at times also found impacted in the middle third. For their removal a longitudinal incision is made through the coats of the ureter, and when the calculus or other foreign body is removed the ureteral wound should be closed with sutures through the outer and middle coats. The upper end of the ureter may be reached through a lumbar incision, as in the operation for nephrotomy or nephrectomy. Calculi have been removed from the lower end of the ureter by an incision through the rectum, the vagina, and the bladder.

It seems likely that operations for the removal of calculi impacted in the ureters will be more frequent and more successful in the near future. Cabot says: "If a stone is lodged in the abdominal portion of the ureter, it may be reached by an incision on the line mapped out by Israel, which starts at a point on the anterior edge of the sacro-lumbar mass of muscles a finger's breadth below the fifth rib, is carried parallel to the rib as far as its tip, then turns down toward the middle of Poupart's ligament till the line of usual incision for tying the iliac artery is reached, then again turns toward the middle line, and ends on the external border of the rectus muscle. According to the seat of the calculus the incision will be made on the posterior, middle, or anterior third of this line. In the first three inches of its course it may also be reached by an incision along the outer edge of the quadratus lumborum muscle, and this opening gives sufficient room for examination of this part of the

[1] *Verhandlungen der Deutsch. Gesellsch. für Chir.*, 1892, p. 43. [2] *Op. cit.*
[3] *Ann. of Surg.*, Sept, 1894.

canal, except in cases where the ribs and iliac crests are unusually near together. The dissection should be quickly carried down to the peritoneum, and this membrane should be separated from the parts beneath, the finger pushing readily in behind it. The ureter, as has been said, adheres to the peritoneum and is lifted up with it.

"The relation of the ureter upon the right side to the vena cava inferior should be remembered, and care should be taken in searching for it. If a stone is impacted in the ureter, it can usually be easily found by palpation through the wound, and this greatly simplifies the search for the canal. In the upper part of the pelvis the ureter may be reached by an incision along the lower end of Israel's line, and in a child or thin person it might be accessible in this manner even to a point behind the bladder. Practically, however, in adults of ordinary development the lower three or four inches of the canal cannot be reached through an extraperitoneal incision in front."

In the lower part of the canal, a region where calculi are often impacted, the ureter cannot safely be reached through the anterior incision. In the female the calculus can often be felt near the cervix and can be removed by an incision through the vault of the vagina. In the male it has been suggested to do a resection of the sacrum. I do not know that the operation has ever been performed.

Albarran in the most recent study of ureteral calculi and fistulas[1] considers as follows the surgical procedures which seem to him advisable in the presence of a calculus, a fistula, or a stricture of the ureter seated in the lumbar, the iliac, or the descending portion of the pelvic part of the ureter: Let us suppose a simple case—a calculus enclosed in the ureter, without consecutive fistula. The injury caused the ureter by a stone opens an easy avenue for the passage of micro-organisms. The periureteritis will then probably suppurate, and if it open outside will become the origin of a ureteral fistula. The formation of periureteral abscesses is the same as of the urinary periurethral abscesses. According to the virulence and the number and kind of germs the lesions will be proliferative or suppurative.

The diagnosis of the point of obstruction cannot be established in the majority of cases, but will be determined at the time of the lumbar incision, to which one should give the preference. The incision may be prolonged below, and the search continued if the calculus is not found in the neighborhood of the kidney. The calculus having been located, the effort should be made to displace it toward the pelvis of the kidney, as has been done by Israel, in order to be able to remove it by nephrotomy. If this proceeding fails, a longitudinal incision should be made in the ureter, preferably above the stone. Some authors, as Ralfe, Godlee, and Cabot, are content with draining the wound without sewing the ureteral wound. Others (Lane, Cullingworth) have sutured the ureter. Albarran prefers to employ sutures in the wound in the ureter in aseptic cases, but not in the presence of septic conditions. Before deciding upon one or the other of these two methods of procedure the ureter must be catheterized to ascertain if any other calculi be present or if there be any narrowing of its lumen.

[1] *Ann. des Mal. des Org. gén.-urin.*, March, 1895.

The exploratory catheterization of the ureter is frequently very difficult; sometimes an instrument cannot be passed from above downward. In these cases the writer advises catheterization from below upward by the endoscope, or, if necessary, by suprapubic cystotomy.

Küster, finding obliteration of the ureter 3 cm. below the pelvis of the kidneys, resected 3 cm. of the ureter, including the strictured portion, and fastened the distal end to the lower part of the renal pelvis. The patient was cured. Weller van Hook in a precisely similar case practised the same operation, with this difference: a ureterotomy was performed below the stricture, which he could feel by passing a sound into the ureter and a finger in the kidney. As the ureter was found strictured lower down, it became necessary to perform nephrectomy. This case illustrates the value of catheterizing the ureter. Cramer has operated successfully on two cases—one a hydronephrosis and the other a pyonephrosis—operating on the ureter at the most dependent portion of the distended part of the pelvis. The operation of Küster is applicable only to strictures near the kidney. It would not be suitable if the ureter was permeable. In the latter case the operation of Fenger, to make a longitudinal incision in the stricture and suture in a transverse direction immediately, as in the Heinecke-Mikulicz operation for stenosis of the pylorus, is to be preferred.

A ureteral stricture situated lower down, from whatever cause it may arise, should be incised throughout its whole length, and the canal explored to determine whether it is patent. If the condition of the ureter permits, an immediate transverse suture should be made. If infection precludes suture, a permanent catheter should be introduced and the wound filled with gauze to allow granulation to take place around the catheter, as in external urethrotomy.

If the stricture is found at a point distant from the place of incision, as when the exploration has been carried on through a wound of the kidney, Albarran advises that there should be a patient effort to pass through the stricture a "bougie armée," and then, over this as a guide, the urethrotome devised by him should be slipped and internal ureterotomy follow.

When the obstacle is near the bladder and obstruction is complete, the best operation is to transplant the ureter into the vesical wall by the transperitoneal or vaginal routes, as has been done by Novaro, Bazy, Mays, Kelly, and Penrose. In extensive obliteration of the ureter it would be better to suture the proximal end in a lumbar incision, producing a surgical cutaneous fistula, as advised by Le Dentu. If but a small section of ureter is resected, the two ends may be sewed together, as was done successfully by Hocanegg in the course of a hysterectomy, during which 4 cm. of the ureter were removed. Several successful cases of this kind are reported, but always in connection with gynecological operations. In the rare cases of the obliteration of the ureter in which the distal end cannot be located, the proximal end may be sewed into the intestine, as was done by Thomas Smith in 1879, and with brilliant success by Chaput.

Dr. H. A. Kelly[1] has reported a case in which a gonorrhœal pyelitis and pyo-ureter were cured by irrigation. The patient came to him with

[1] *Bulletin of the Johns Hopkins Hospital*, Feb., 1895.

an extensive accumulation of pus in the left ureter extending up into the pelvis of the kidney. This was caused by a stricture at the vesical end of the ureter, with a dilatation above it, and was associated with gonorrhœal infection. He treated the stricture by dilating it with a series of urethral catheters, increasing in diameter from 2 mm. up to 5 mm. After drawing off the purulent fluid the ureter and pelvis of the kidney were washed out with medicated solutions. The calibre of the stricture was enlarged, reducing the quantity of the accumulation above it from 150 cc. to 100 cc. The purulent character of the secretions was removed and all trace of gonococci disappeared.

Dr. Kelly believes the following novel and important points to be demonstrated by this case: 1. Stricture of the lower extremity of the ureter can be diagnosed without any operation by using the cystoscope, with the bladder dilated with air by posture. 2. Stricture of the ureter can be improved by gradual dilatation with a series of hollow bougies (catheters) and without a kolpo-ureterotomy.[1] 3. A stricture through which a No. 5 (5 mm. diam.) bougie is passed every day for several weeks will still hold back the urine if the walls of the ureter above have lost their contractility. 4. Pyo-ureter and hydro-ureter can be diagnosed by drawing off in a few minutes such a quantity of fluid as it is manifestly impossible for the kidney to secrete in that amount of time. 5. Pyo-ureter and pyelitis can be cured by washing out the ureter and pelvis without any preliminary cutting operation to disclose the ureteral orifice (as in kolpo-uretero-cystotomy.—Bozeman). 6. Variations in pressure in the column of fluid in a distended ureter can be demonstrated by a manometer attached to the ureteral catheter 7. In this way the course of the ureter can be mapped.

Ureteral fistulas occur most frequently in women, and are the result of lacerations during labor or from ulcerations produced by ovarian or uterine tumors. The subject therefore belongs more particularly to the department of gynecology, and will be further described in the appropriate article.

The conclusions at which Fenger arrived after an elaborate experimental and clinical study of the subject are in the main sound, and present such a good synopsis of the present state of surgical knowledge on the subject that they are here transcribed in full, except such portions as have already received attention in this section: "Accidental wounds and subcutaneous ruptures of the ureter have not as yet been objects of direct surgical procedure upon the ureter at the seat of lesion. It will be advisable, however, when and as soon as the diagnosis can be made, or when a lumbar opening of a periureteral cavity containing extravasated urine is made, to look for the seat of rupture, and if practicable to restore the continuity of the canal. Catheterization of the ureters from the bladder for purposes of diagnosis of diseases of the kidneys has given valuable information affecting the decision for or against operation on the kidney. The procedure is reasonably practicable in the female by the methods developed by Simon, Pawlik, and Kelly. In men catheterization is practicable only through epi-cystotomy. The danger of this operation is steadily decreasing. The old mortality, which varied from 27 to 20 per cent., has been reduced in

[1] See Kelly: *Johns Hopkins Gynecological Report*, No. 1.

the more recent series of operations. Albert has had 20 cases with 1 death; Assendelft, 102 cases with 2 deaths; Ultzmann, 9 cases with 1 death; Bergman, 10 cases, all without a death. Therefore this procedure is justifiable in selected cases.

"Catheterization of the ureter from the bladder as a curative measure for the evacuation of hydronephrosis or pyonephrosis has occasionally been performed successfully (Pawlik). It is more difficult and more uncertain than nephrotomy or the attempt to find and remedy the stenosis of the ureter from the pelvis of the kidney.

"Dilatation of strictures of the ureter by elastic bougies or catheters has been tried from the bladder by Kelly with temporary success, and from the pelvis of the kidney by Alsberg successfully; consequently, this procedure is of use in isolated cases.

"Permanent catheterization of the ureter from the bladder, of a fistula, or of an implanted ureter is often tolerated only for a limited time, and must be employed with caution for fear of causing ureteritis.

"Uretero-lithotomy, longitudinal incision over a stone for its removal, is a safe operation by the extraperitoneal method. The wound heals without stenosis. In extraperitoneal operations suturing is unnecessary, drainage down to the tube being sufficient.

"In valve-formation or stricture of the ureter, causing pyonephrosis or hydronephrosis or a permanent renal fistula, nephrotomy should be followed by exploration of the ureter in its entire course from the kidney to the bladder.

"Exploration of the ureter as to its permeability should be done from the renal wound by a long, flexible, silver probe (a uterine probe) or an elastic bougie, either olive-pointed or not. If the bougie passes into the bladder, the examination is at an end. The size of bougie that will pass through a healthy ureter is from 9 to 12 French scale.

"If the pelvic orifice of the ureter cannot be found from the renal wound, it should be sought for by opening the pelvis (pyelotomy) or by ureterotomy.

"A longitudinal incision, half an inch to an inch long, in the posterior wall of the pelvis can be made while the kidney is lifted upward against the fifth rib. This procedure is easy if the pelvis is dilated, but may be impossible if the pelvis is of normal size.

"Operation for valve-formation should be done through the wound in the pelvis. If the opening cannot be seen or found from the pelvis, ureterotomy should be performed immediately below the pelvis; a small incision should be made in the ureter and a probe passed up into the pelvis. The valve should be split longitudinally, and the incised borders so treated as to prevent re-formation of the valve.

"A stricture in the ureter, if not too extensive, can be treated by a plastic operation on the plan of the Heinicke-Mikulicz operation for stenosis of the pylorus—namely, longitudinal division of the stricture and transverse union of the longitudinal wound. This method for operating for ureteral stricture seems to be preferable to resection of the strictured part of the ureter (Küster's operation) for the following reason: It is a more economical operation, and preferable when the elongation of the ureter is not sufficient to permit of closure and invagination without stretching.

"Resection of the upper end of the ureter and implantation of the distal end into the pelvis may be useful in rupture or division or stricture of the upper end of the ureter, as described by Küster.

"The vesical orifice of the ureter may be reached from within the bladder by suprapubic cystotomy in man, and by dilatation of the urethra or suprapubic or vaginal cystotomy in woman.

"Uretero-uterine fistulas can be treated satisfactorily by plastic closure of the vagina or by nephrectomy. Implantation of the ureter into the bladder is, under favorable circumstances, the operation of the future for this condition.

"Uretero-vaginal fistulas and congenital urethral or vaginal terminations of the ureter should be treated by vaginal plastic operation for displacement of the proximal end of the ureter into the bladder. If these attempts fail and the kidney is not infected, extraperitoneal or transperitoneal implantation into the bladder should be done, and finally, as a last resort, nephrectomy.

"Complete transverse wounds in the continuity of the ureter should be treated by uretero-ureterostomy after Van Hook's method of lateral implantation if possible.

"Complete transverse wounds of the upper end of the ureter should be treated by implantation into that viscus, either by splitting the ureter or by invagination.

"Loss of substance of the ureter too extensive to permit of uretero-ureterostomy, or too high up to permit of implantations into the bladder, may be treated by implantation on the skin or into the bowel.

"Implantation into the bowel is objectionable on account of the infection which is almost certain to follow sooner or later.

"Implantation into the rectum should not be resorted to when implantation into the bladder is possible.

"Implantation on the skin in the lumbar region or the abdominal wall may have to be followed by secondary nephrectomy, which, however, is much less dangerous than the primary operation."

No apology is needed for giving this subject such extended consideration. Every surgeon who has had cases of renal fistulas, and who has been forced to nephrectomy in the face of serious doubt as to the condition of the opposite kidney, will welcome any suggestion which looks to the successful treatment of the ureteral conditions at the time of the primary operation, whatever that may have been.

SUPRARENAL CAPSULES.

According to Le Dentu, suppuration in the suprarenal capsules is always due to tuberculosis, which may assume any of its forms in these organs, and often gives rise to enormous increase in their size. They may also be, so says the same learned author, the seat of malignant tumors frequently secondary to malignant diseases elsewhere in the body. Under these conditions the organs are converted into mere hæmatomata.

It may be of use on bibliographical grounds to note the following records, which may prove of use to the practitioner: A case of sarcoma

and also one of adenoma are reported by Pelliet.[1] A case of fibroma is reported by Letulle.[2] Hervey observed a case of rupture of the suprarenal capsule in a newly-born child.[3] Le Dentu noted a case of gunshot wound in which the patient lived four weeks.[4]

Surgical intervention in case of disease of the suprarenal capsules other than for the removal of tumors is unknown. Thornton[5] reports having removed a large sarcoma of the suprarenal capsule and of the capsule of the left kidney by nephrectomy.

The subject of the surgery of wounds of the suprarenal capsule calls for no further notice. "There are no clinical records," says Morris (p. 181), "of any case of uncomplicated wound of the suprarenal capsule."

Diseases of the Bladder.

CONGENITAL DEFORMITIES.

Entire absence of the bladder is a rare anomaly; a few cases however, have been reported. The ureters are then found to open directly into the urethra, vagina, or rectum. Cases of urethral opening of the ureters have occurred which have been discovered only at the post-mortem, the patient having been in no manner inconvenienced during life. In these cases the ureters become dilated, and form, as it were, two separate small bladders, and the outlets of the ureters in the mucous membrane of the urethra (being sufficiently controlled by the natural spasmodic contraction of the parts) act as sphincters.

These abnormalities, however, are usually associated with other abnormalities of the pelvic organs, such as imperforate anus, undescended testicles, etc. Operative interference is not attended with much success; attempts have been made to direct the course of the urine into the rectum or intestines, as in cases of exstrophy.

Multiple bladders have been observed, but in the greater number of such cases there is present merely a multilocular or sacculated condition of the main bladder. The possibility of such a condition should be always remembered when we meet with obscure symptoms of calculus.

Exstrophy is a congenital malformation in which the anterior abdominal and vesical walls are lacking and the posterior wall and fundus of the bladder protrude through the abdominal opening.

The external genitals are at the same time much distorted, and, in the male, where this malformation more frequently occurs, the penis is usually completely epispadic and rudimentary. With exstrophy double complete inguinal hernia is also sometimes associated, due probably to the condition of the abdominal wall, which is generally weakened and unsupported. The lack of bony union in the symphysis pubis is evidence that this interruption of development has taken place at about the second month of fœtal life, before the ossification of the pubic bones has started. The arrest of development in these parts is thought to be due to pressure by the umbilical cord when either its point of entrance

[1] *Bulletin dé la Société anatomique*, pp. 414, 672, 1888. [2] *Ibid.*, p. 302.
[3] *Ibid.*, p. 263. [4] See appropriate chapter in *Affections chir. des Reins, etc.*
[5] *Lancet*, Mar. 22, 1890.

into the fœtus or a disproportionate weight of the upper extremities and head do not permit of proper balancing of the fœtus in the amniotic fluid, thereby causing the head to hang downward. The cord is thus pressed tightly against the abdominal wall as it passes up between the legs of the fœtus.

The exposed and irritated mucous surface of the bladder as it bulges through the opening in the abdominal walls presents so characteristic an appearance in all cases of exstrophy that the condition cannot be mistaken. Furthermore, the openings of the ureters, discharging the urine drop by drop, may usually be seen, and the inner surfaces of the thighs and of the perineum become excoriated and eczematous from constant urinary irritation.

Treatment.—Many ingenious forms and varieties of urinals have been devised to catch and collect the urine and also to protect the exposed mucous membrane, but none are really successful and the patient's life is a burden. Nature's blunders are, *ipso facto*, irremediable, and human operations can only feebly countervail them; hence it follows that in this case continence of urine cannot be completely established. Our best efforts can succeed only in concentrating the outflow at one point, where a urinal can be applied.

Attempts have been made to set up a communication between the ureters and the rectum, but this operation has not been successful.

On the whole, the most satisfactory operation is that of Professor Wood of London, which consists of dissecting up an oblong flap of skin from the abdomen between the umbilicus and the upper margin of the abdominal opening, which flap is hinged so that when it is folded over, its skin-surface is opposed to the mucous membrane of the bladder; then two flaps are dissected up from the inguinal region and twisted around so as to meet in the median line and cover over the raw under surface of the first flap. The upper flap should be raised with care, so as to preserve as much thickness of tissue as possible, and the portions left attached to the upper margin of the exposed surface of the bladder should be as broad as possible, so as to secure a sufficient vascular supply. After this flap is folded over, its upper (not its lower) edge should be attached by sutures to the cut edge at the root of the penis on each side. There should be not the least tension on this or on the superposed lateral flaps. The raw surfaces left may be lessened by the judicious use of interrupted sutures. I am in the habit of securing relaxation of the general abdominal wall anteriorly by broad strips of adhesive plaster running from one loin to the other, and extending from the lower ribs to just above the upper margin of the wound left by the dissection of the upper flap. Greig Smith,[1] Mayo Robson,[2] and others have modified this operation, and the ingenuity of the operator may be exercised in special cases, but the main details of the procedure should be as above.

Ayres's operation is virtually the same, except that the two side-flaps are taken from the abdominal wall bordering on the edge of the exstrophy and the margin of the central flap.

Maury's operation consists in dissecting up a large convex flap from the scrotum and perineum, which (a small slit having been cut, through

[1] *Brit. Med. Journ.*, Feb., 1890. [2] *Ibid.*, Jan. 31, 1885.

which the penis is slipped) is turned up, skin-side in, over the exstrophy and slipped under the abdominal skin at the upper border of the opening. The flap is then retained in place by means of the tongue-and-groove suture. A contingency unforeseen when this ingenious operation was devised has to a large extent rendered it of doubtful use. At the age of puberty pubic hairs are started and grow inside the bladder, and frequently become the nucleus of calcareous deposits.

Thiersch's operation consists of several stages. The flaps are lateral, and are made so that one covers the lower half of the bladder, and the second, made after the first has soundly healed, is taken from the opposite side and closes in the upper half. Still later the contiguous margins of the two flaps are freshened and united, and finally the upper margin of the second flap and superior edge of the opening in the abdominal wall are revivified and sutured. The treatment extends over a year.

Trendelenburg has introduced an operation intended to close the gap between the two pubic bones. He divides the sacro-iliac synchondrosis on either side and brings the bones together, afterward freshening, approximating, and suturing the lateral margins of the defect. He thinks the operation suitable for children between two and five years, preferring the latter age.

Makins[1] has described an apparatus by which, through the employment of a pelvic belt and loops of webbing, weight-extension may be employed and the ilia drawn together.

Treves[2] sums up as follows the general results of the various operations: "The results claimed in the most successful cases are—that the raw surface of the bladder is protected and covered in, and that a urinal can be worn which will keep the patient quite dry. Many patients are free from the inconvenience of incontinence when they are lying down, but in no instance can it be claimed that the patient has acquired a control over the bladder. These results, however, are very satisfactory when the miserable condition of the patients before operation is considered."

In placing the circumstances of operative treatment before the patient's friends the following facts must receive due consideration: 1. Patients with ectopia have reached old age and have had no operation performed. 2. It may still be possible to secure an apparatus which will protect the bladder and efficiently collect the urine. 3. The treatment is tedious and painful and may extend over many months or even years; in one case treated by Billroth no less than nineteen operations were performed. 4. The operative treatment is not without risk.

CYSTOCELE, or hernia of the bladder, occurs occasionally as a consequence of diseases or injuries which obstruct the outflow of urine. The bladder-walls become thin and relaxed, from constant over-distention, and the frequent efforts at expulsion of the contents force the viscus into an unnatural position. A cystocele may also occur in connection with a hernia, and is then due to the same causes. A hernia of the bladder descending into the scrotum may be mistaken for hydrocele or encysted hydrocele of the cord; the urinary symptoms, however, almost always render the diagnosis easy. The inguinal or scrotal tumor is reducible by pressure, and its reduction is always followed by a desire to urinate.

[1] *Med.-Chir. Trans.*, 1888.

[2] *Operative Surgery*, vol. ii. p. 113.

Strangulation is very rare, but angulation may occur, and from the retention of decomposing urine calculi may form in the displaced portion, and may then be mistaken for nodules of malignant growth.

One important guide in the diagnosis is, that after urination the soft fluctuating tumor diminishes in size, and in the intervals between urination it gradually increases.

Treatment is practically the same as for enterocele: either palliative by means of a truss, or an operation for radical cure. If the cystocele be reducible, it is to be put back in the usual manner by manipulation while the urine is being evacuated either voluntarily or by means of a catheter, and the truss adjusted to keep the organ in place; if adhesions have formed and reduction is impossible, the hernia may be checked by means of a truss with a cup-shaped pad. An operation for radical cure, much the same as that known as Bassini's operation for inguinal hernia, may be employed.[1]

It must be remembered, however, that cystoceles, unless very large, or unless associated with a hernia of the intestines, do not have peritoneal sacs, owing to the lack of peritoneal covering over a considerable surface of the bladder.

INVERSION (or *extroversion*) of the bladder is excessively rare; it is only possible in women who have a lacerated meatus urinarius or a short and relaxed urethra; in these cases an invaginated fold of the bladder protrudes through the meatus. There has been usually a history of incontinence. In the male this condition is of course impossible. Instances, however, have been reported where a portion of the mucous membrane became prolapsed in the urethra, but only as far as the membranous portion.

Treatment consists in replacing the prolapsed portion and in retaining it in position with a catheter, then contracting the dilated urethra and meatus by means of frequent applications of the actual cautery.

ATROPHY of the bladder is a condition of comparative frequency in old age or in cases of paralysis where the bladder is constantly overdistended from retention or constantly emptied from incontinence. It is not an atrophy of one of the coats alone, but of all of them. The viscus becomes remarkably thin and is easily torn. Cases of rupture from pressure through the abdominal walls during catheterization have been recorded.

HYPERTROPHY of the bladder is always secondary to other diseases of the genito-urinary tract, mainly to obstructions to the outflow of urine. Both acute and chronic cystitis are apt to be followed by hypertrophy; owing to the irritation caused by the cystitis the bladder is frequently emptied, and the muscular coats are subjected to an undue amount of action and straining, whereby they are unduly increased in bulk, and either a *concentric* or an *eccentric* hypertrophy of the organ ensues.

The *concentric* form, consisting of a general thickening of the walls and a diminution of the cavity, results from any irritation (such as foreign bodies in the bladder, calculi, or chronic cystitis) which leads to constant efforts at micturition and consequent over-nutrition of the muscular coat. The diminution of the cavity, in direct ratio to the hypertrophy, naturally works in a vicious circle: the smaller the cavity the

[1] See *Morrow's System*, vol. i. p. 540.

more frequent will be the necessity of emptying it, and the more frequently it is emptied the more will the muscles be called into play, and the more these are called into play the greater will be the hypertrophy and the constriction of the cavity. For this reason the prognosis depends largely upon the curability of the original cause.

The *eccentric* form of hypertrophy is usually the result of urethral strictures, and consists of a general enlargement of the bladder, and this condition may be further complicated by the formation of pouches of mucous membrane which slip through the fasciculi of the muscular coats, and in which decomposing urine is retained and calculi may be formed.

Treatment consists in removing the primary cause. If this be stricture, dilatation will usually be sufficient, but irritability may still persist even after this cause is removed, and then cystotomy and irrigation are the best means of giving the organ complete rest and preventing irritation due to ammoniacal urine retained in the diverticula; by this means also, in some degree, atrophy may result from the absence of expulsive efforts.

PATENT URACHUS is a congenital deformity probably due to an obstruction in the normal outlet of the urine during intra-uterine life, at that period when the upper half of the intra-abdominal portion of the allantoïs usually becomes converted into a fibrous cord extending from the umbilicus to the top of the bladder. The malformation may be recognized by the dribbling of urine from the umbilicus, which becomes excoriated and possibly encrusted with urinary salts. The usual means of closing fistulas—namely, by curetting the walls of the canal, by the application of actual cautery, and by various plastic operations—are to be adopted only after the obstruction has been removed and the urethra has been rendered freely penetrable, whereby the escape of urine through the abnormal passage has been checked. Perineal cystotomy and drainage may be employed with male patients in order to put the bladder completely at rest, but forcible dilatation of the whole urethra is with female patients generally sufficient.

INJURIES AND WOUNDS OF THE BLADDER.

Punctures and rents in the bladder-wall may occur in many ways and at many points. The viscus may be lacerated from force applied externally, as in gunshot wounds, stabs, crushes, etc., in which there is a direct communication with the external wound and with the interior of the bladder; or it may be torn and cut by fragments of bone with no external communicating wound, as in cases of fracture of the bones of the pelvis from severe falls or crushes; and, furthermore, the rupture of the vesical walls may be entirely due to force from within—namely, from over distention with urine. This last is more rare than either of the other causes of rupture. It occurs when there is obstruction to the outflow of urine and a coexisting sacculated or deeply ulcerated condition of the vesical walls.

The wound may be—1st, extraperitoneal; 2d, intraperitoneal; and 3d, subperitoneal.

1. *Extraperitoneal.*—Wounds or ruptures of the walls are most likely

to occur when the symphysis pubis has been fractured or violently torn apart, or from gunshot wounds or stabs just above the pubis, the bladder being distended at the time of wounding—an accident of common occurrence during the War of the Rebellion. It is a matter of familiar experience that the bladders of soldiers are apt to be distended before and during action. Rupture may also occur at the base of the bladder if the man has fallen from a height, landing on his feet or buttocks, at a time when the bladder is distended. In these cases the vesical wall may be ruptured just behind the prostate, where the peritoneum is reflected upon the rectum; when the bladder is distended this fold of peritoneum rolls up on the posterior surface of the bladder to a considerable extent.

2. *Intraperitoneal.*—Rupture of the vesical wall occurs through that portion which is covered by the peritoneum much more frequently than through the extraperitoneal portions. This is most probably due to the fact that the area covered by the peritoneum is about three times as large as that which is not so covered; it has been suggested also, as an explanation of this greater frequency of intraperitoneal ruptures, that when this portion of the bladder is put to a strain the peritoneum, less elastic and distensible than the other coats, is first stretched and then splits, tearing the muscular and mucous coats of the bladder with it.

3. *Subperitoneal* ruptures are those which occur in the portion covered by the peritoneum, but which only penetrate the vesical wall proper. This form is most insidious and most difficult to detect; it is, however, rare. All the symptoms of rupture may be present, yet when an exploratory abdominal opening is made a wound of the bladder or peritoneum is scarcely to be discovered.

Symptoms.—There is always a clear history of injury or of violence occurring while the bladder is distended, followed by sudden pain and collapse. The patient finds that, although he has an urgent desire, it is impossible to urinate: only a few drops of blood or of bloody urine issue from the urethra. If there be an external wound, the diagnosis is easier; urine will be seen coming from the wound. In cases of rupture from over-distention the patient will feel sharp lancinating pain, followed by an instant cessation of all desire to urinate; this in turn is succeeded by collapse and symptoms of peritonitis. A catheter passed into the bladder will withdraw only a few drops of bloody urine, although the patient may not have urinated for several hours.

To make sure of the **diagnosis**, a measured quantity of boric-acid solution may be injected into the bladder, observing at the same time whether or not the viscus rises above the brim of the pelvis; when an attempt is made to withdraw this solution, if there is a rent in the vesical walls, all of it will not flow out again. Filtered air also may be used to test the integrity of the walls. If they are intact, the viscus will rise above the pelvis as a tympanitic tumor, but if the walls are ruptured, the air simply penetrates into the peritoneal cavity, or if the rupture is extraperitoneal, the air will enter the perivesical cellular tissue.

When the lesion is in the extraperitoneal portion the urine will infiltrate into the prevesical space (the space of Retzius) and may extravasate into the abdominal walls, sometimes as high as the chest; also into the perineum, scrotum, and penis, and down the thighs through the inguinal

canal and obturator foramen. In intraperitoneal rupture the urine flows directly into the peritoneal cavity. The skin over the portions of the body into which the urine has infiltrated, at first becomes reddened, then flabby and œdematous; finally dark, gangrenous spots appear and the tissues begin to slough.

Occasionally all this train of symptoms develops rapidly and unmistakably; nevertheless, it is quite possible for rupture of the bladder to occur and yet not manifest itself for many hours, perhaps days, by the development of any of these symptoms. It is possible for the rent in the bladder to be at once filled by a loop of intestine, which prevents the escape of urine and masks all the urinary symptoms, the patient experiencing nothing more than slight pain during micturition until contraction of the wound produces peritonitis and symptoms of intestinal obstruction. In a similar manner the edges of the wound may act as valves, and thus prevent the escape of urine, or of injected water, or of air. It is therefore of the greatest importance in cases where rupture may be reasonably suspected to keep the patient under the most careful observation for several days if an exploratory incision be not deemed justifiable at once.

Treatment.—The success of any operation for a rupture of the bladder depends chiefly upon the promptitude with which it is undertaken. Incision should be made in the linea alba, as for suprapubic cystotomy, avoiding the peritoneum. If the rupture has not taken place in the extraperitoneal wall, but in the intraperitoneal wall, then a laparotomy should be performed and the peritoneal cavity washed out and drained. Intraperitoneal wounds may be sutured with a very fair degree of assurance that healing will take place rapidly, provided that they are of recent date and the edges are not severely lacerated. In the latter event so much manipulation is necessary in order to approximate the edges accurately that it is best to rely upon efficient drainage of the abdominal cavity and upon permanent drainage of the bladder through a perineal incision. If the wound be sutured, the stitches should penetrate only through the serous and muscular coats, and the mucous membrane should be inverted. They should be not more than a quarter of an inch apart. When all the sutures have been placed—they should extend beyond both ends of the rent—the bladder should be moderately injected to test the tightness of the seam, and any leakage stopped by an additional suture. The adoption of the Trendelenburg position is thought by many operators to facilitate the whole procedure.

When the wound is extraperitoneal the value of immediate suture is doubtful. In these situations there is not the chance that adhesions will form as rapidly as when serous surfaces are approximated; if the edges of the wound have been bruised, as is more than likely to be the case, slight sloughing may ensue and the stitches will lose their hold. The open-drainage method of suprapubic cystotomy gives such good results that it is hardly worth the risk of subsequent leakage and urinary infiltration to close the wound at once, unless it be small and of very recent occurrence. It is an extremely difficult operation at best, since the bladder sinks down close to the pubic bones. In any event, the prevesical space should be kept open for some time by means of a drainage-tube: a buttonhole perineal opening carrying a tube large enough to fill it adds

little or nothing to the gravity of the condition, and secures good drainage no matter what method of treatment of the wound has been adopted. It is but fair to add, however, that in one recorded case[1] death was attributed to persistent hemorrhage from the incision in perineal urethrotomy made for the reason suggested above. This must be a very rare occurrence; I have never seen a death from this cause. On the other hand, the advantages of the procedure, both in preventing the escape of the urine into either the peritoneal or prevesical spaces and in favoring union of the wound if it has been sutured, is obvious.

When extravasation has taken place numerous free incisions, three to five inches or even more, in length, should be made over the infiltrated areas. Hemorrhage will usually not be at all severe, and soon ceases; small but vigorously spurting arteries may be ligated. In free drainage by incision lies the only hope.

Extraperitoneal ruptures of the bladder may heal spontaneously. In a case recently under my care a large swelling formed in the hypogastrium consecutive to a contusion received while the bladder was full. The patient came to the University Hospital some weeks later with an evident prevesical abscess. On laying this freely open and packing it, healing took place promptly. The contusion had been followed immediately by hæmaturia and marked vesical symptoms which had been treated expectantly.

The prevesical space (cavum Retzii) is subject to the invasion of other forms of infection than that conveyed by the urine. Thorndike[2] has reviewed the existing literature upon the subject, which has not been embodied in the majority of surgical treatises: The prevesical space, often called the cavity of Retzius, is a shallow space entirely external to the peritoneum, and serves in part to give the bladder room in which to expand when filled with urine. It is bounded anteriorly by the pubes and the anterior layer of the transversalis fascia of Cooper, and behind by the bladder and by the posterior layer of this same fascia. The part of the space which extends upward beyond the pubes is limited above by the line of union of the two layers of fascia which are given off at the lower border of the sheath of the recti muscles posteriorly, and has for its side-limits the union of these layers with the aponeurosis of the transversalis and the oblique muscles. Below, the space is limited by the prostatic sheath and the superior aponeurosis of the true pelvis, so that pus in this space can get back to the rectum and to the iliac fossæ on either side of it.

As may be supposed, suppuration in this region occurs as a result of traumatism (operative or otherwise), as a result of disease in neighboring organs, such as the bladder, prostate, uterus, etc., and even a gonorrhœa has been the direct cause of prevesical suppuration; in one or more instances as a result of metastasis in pyæmia or typhoid fever.

Englisch (quoted by Thorndike) has studied and tabulated 23 cases of so-called idiopathic prevesical inflammation, and adds 10 more from his own experience. In none of these could any possible cause for the inflammation be assigned. He thinks that all other cases may be conveniently classed under three headings: 1, those caused by traumatism; 2, by metastasis; and 3, by direct extension from neighboring organs or tissues.

[1] Teale, *Lancet*, June 6, 1887. [2] *Journ. of Cut. and Gen.-urin. Dis.*, Sept., 1893.

The **symptoms** of the so-called idiopathic cases are at first a vague pain, often referred to the bowels and frequently associated with digestive disturbances; the formation of a tumor looking like a distended bladder; some vesical tenesmus and irritability. This tumor may terminate slowly by resolution, or may go on to the unmistakable symptoms of abscess.

Incision through the anterior abdominal wall just above the pubes is clearly indicated whenever the symptoms are strongly indicative of suppuration. Thorndike sums up as follows: There is a large number of reported cases of undoubted prevesical inflammation of which rather less than half subside without suppuration, and rather more than half result in abscess-formations. Many of these cases occur as a direct extension of an inflammatory process from neighboring organs, chiefly the bladder, prostate, and urethra. A few occur as a result of traumatism, and an occasional one is metastatic.

The remaining cases, classed at present as idiopathic, have been carefully studied by Englisch, who reports 33 cases with 4 deaths (12.1 per cent.), all from a general purulent peritonitis following perforation of the abscess into the peritoneal cavity. Of these 33 cases, 14 subsided without operation and without spontaneous opening; 7 were incised and slowly recovered; 12 opened spontaneously—4 through the anterior abdominal wall, 2 into the rectum, 2 into the bladder or urethra, and 4 into the peritoneal cavity.

It is believed by many surgeons, though without proof, as far as the writer is aware, that these abscesses are of tubercular origin. Of Englisch's 10 cases (from his personal experience), 4 had tubercular histories.

The **prognosis** is not necessarily unfavorable, as is commonly stated, for of the 33 idiopathic cases but 4 died (12.1 per cent.), and each from a perforation into the general peritoneal cavity, and in only one of these 4 cases was an attempt made to liberate the pent-up pus by operation.

Foreign Bodies in the Bladder.—In addition to what may be called *natural* foreign bodies—namely, calculi—there have been found in the bladder an almost indescribable and unlimited variety of *unnatural* foreign bodies, such as hair-pins, slate pencils, broken catheters, leather thongs, spicules of bone, etc. etc., which have been introduced, either by accident or from erotic desire, through the urethra, or have found their way into the bladder from neighboring parts of the body by a process of slow ulceration. I have removed from the male bladder a long lamp-wick, the stem of a pipe, a straw encrusted with phosphates, a piece of wax, and other equally extraordinary foreign bodies. When first inserted these foreign bodies are comparatively easy to extricate, but from feelings of shame on the part of the patient the surgeon generally does not see the case until there is a considerable degree of cystitis or until the foreign body has become so encrusted with urinary salts that it is difficult to diagnose it from a vesical calculus of very irregular shape.

The **symptoms** which a foreign body in the bladder produces are almost exactly those of calculus—frequent, painful urination, hæmaturia, pyuria, etc. If the foreign body is of such shape and size that it presses constantly upon the vesical walls, ulceration, and eventually perforation, will occur, with the concomitant symptoms of ruptured bladder either extraperitoneal or intraperitoneal.

Treatment.—The selection of operation for removal of "unnatural" foreign bodies necessarily depends upon the character of the material, and, as far as can be ascertained, the length of time it has been in the bladder. Such bodies as portions of soft-rubber catheters may often be grasped and withdrawn between the blades of a small-sized lithotrite. Mercier has devised a special instrument for the purpose of withdrawing pieces of catheters. The frequency of this accident justifies the manufacture of such an instrument. It consists of two blades like those of a lithotrite: the male blade terminates in a hook with the point directed downward; when closed this hook slides into a fenestration on the female blade and the instrument presents a smooth rounded end. The catheter, being grasped transversely, is doubled up and drawn through the urethra. If the catheter has become encrusted with calculous deposits (usually phosphatic), the crust is first gently broken off by means of a lithotrite. The Nitze cystoscope will be found of great value in determining the nature of the operation to be performed, since by means of this instrument the locality, shape, and size of the foreign body can be accurately observed; the operating cystoscope, which is approaching perfection every day, will possibly solve many of the difficulties in the treatment of these cases. Foreign bodies the shape and size of which prevent their extraction through the urethra should be removed by a suprapubic cystotomy, followed by drainage until the bladder has regained its former condition of health.

In the female the greater capacity for distention of the urethra makes the extraction of foreign bodies much easier, but should it be necessary to perform an operation for their removal, the high operation gives the best results. Enlargement of the urethra by lateral incisions is more than likely to be followed by incontinence of urine; obstinate vesico-vaginal fistula occasionally follows a vaginal cystotomy.

Retention of Urine.

Retention of urine may be due to obstructive causes or to loss of expulsive power in the muscles of the vesical walls. Among the obstructive causes of retention are strictures of the urethra (both spasmodic and organic); acute and chronic enlargment of the prostate; vesical and urethral calculus; foreign bodies; urethral tumors; pedunculated vesical tumors near the internal urethral orifice; malformations of the urethra and of the preputial orifice; artificial constrictions of the urethra, such as rings or pieces of string around the penis; pressure from the uterus during pregnancy; fecal accumulations in the rectum; and pressure from fractured bones of the pelvis.

Retention from loss of expulsive force may be caused by spinal injury and paralysis, either sensory or motor; by reflex inhibition following operations for fistula *in ano* or the ligation of hemorrhoids, or for other surgical diseases of the urinary organs and rectum; hysteria; mental emotions; low fevers; certain drugs, such as belladonna, opium, or cantharides; and atony of the bladder-walls. Acute, voluntary over-distention also causes a temporary paralysis of the muscular coats and is followed by retention.

Symptoms.—If due to acute obstruction of the outlet, the patient

complains of a feeling of intense weight and distention in the lower part of the abdomen and pelvic cavity, combined with an urgent desire to pass water, which may be only partially effective; after violent straining a few drops of urine escape and give slight temporary relief. If the obstruction is complete, the straining is almost continuous; the symptoms increase in severity; the urine is backed up on the kidneys, and toxæmia and death follow if the condition be not relieved. The distended bladder may be felt as a large oval tumor in the lower part of the abdomen, rising above the pelvis up to the umbilicus, dull on percussion and surrounded by an area of tympany; fluctuation may be elicited. In women it has not infrequently happened that an over-distended bladder has been mistaken for a gravid uterus. Urinary obstruction, unless mechanical, is never so complete that there is no escape of urine whatever, and when the bladder becomes much over-distended a condition known as "incontinence of retention" results. This is recognized by a constant oozing of urine drop by drop from the urethra. Retention due to paralysis of the muscular coats of the bladder or to an obstruction which produces retention so gradually that no painful sensations are experienced is rendered more insidious from this symptom of constant dribbling. The patient is led to believe that his bladder is constantly being evacuated, whereas it is in reality becoming enormously distended. One of the most accurate means of detecting this distention is by rectal palpation; a finger introduced into the rectum readily discerns the tense, rounded organ pressing down like a tumor behind the prostate, and the impulse from pressure on the abdomen can be felt at once.

Treatment.—Catheterization naturally presents itself as the first thing to be done, unless it is known to be impossible owing to an impermeable stricture. If, however, the general condition is not serious and the retention is due to a spasmodic stricture, much may be done to relieve the patient before instrumentation is begun. Hot baths, cloths wrung out of hot water placed over the hypogastrium, warm rectal douches, opium, etc. may be tried, and will often relax the spasm of the sphincters or of the urethra. Catheterization, however, should be attempted at once if the symptoms are at all serious. If no instrument larger than a filiform bougie can be passed and the bladder be not seriously distended. the bougie should be tied in and the urine allowed to dribble away alongside of it. Considerable relief can often be afforded in this manner, and time is allowed to prepare the patient for an operation of more permanent relief. If the symptoms be very urgent and it be impossible to pass instruments by the urethra, the bladder may be aspirated and the urine allowed to escape.

There are four points of entrance which may be employed for vesical paracentesis—namely, suprapubic, subpubic, perineal, and rectal.

The *suprapubic* puncture is to be recommended on account of its safety and the certainty of reaching the bladder when well distended. Ordinary antiseptic precautions are necessary, including shaving of the pubic hairs. The trocar (of small size) is inserted just above the symphysis pubis in the median line and directed slightly downward. When the urine has been drained off and the cannula removed the wound should be closed with a patch of antiseptic gauze and iodoform collodion. If a catheter is to be retained in the wound, it should be slipped through the

cannula, which is then withdrawn over it, and the catheter retained in place by strips of adhesive plaster.

The *subpubic* puncture is made close to the under edge of the pubic bone just above the penis, which is drawn downward. The advantage claimed for this method is that troublesome adhesions do not form between the bladder and the anterior abdominal wall, as they are apt to form after the suprapubic puncture. But this operation has found no favor, owing to its being somewhat difficult to perform. The opening is in an inconvenient position, and there is also danger of wounding the artery and vein of the dorsum of the penis, and, after all, the bladder may not be reached.

In the *perineal* puncture (or Cock's operation) the opening is made from the perineum through the apex of the prostate and into the bladder through the prostatic urethra. Harrison's operation consists of puncturing the bladder from the perineum through the body of the prostate. It is designed to relieve permanently cases of chronic retention due to prostatic enlargement. It is well adapted for perfect and convenient drainage in cases of cystitis.

Puncture through the *rectum* is rarely performed at the present day. The situation is inconvenient, and there is, besides, some danger of wounding the recto-vesical fold of the peritoneum. In this operation the bladder is punctured behind the base of the prostate directly in the median line. Defecation greatly interferes with any attempt at permanent drainage in this situation; it is almost impossible to keep the cannula in place. Therefore, as Fowler says, "as a temporary expedient it is unnecessary and as a permanent means of drainage it is useless."

The operation of prostatectomy for the relief of chronic retention from prostatic enlargement has been quite freely practised of late years, and will be described in the section on Diseases of the Prostate.

The catheterization of patients with retention from prostatic enlargements Buckston Browne[1] maintains to be only a question of time and skill; the catheter—only soft instruments should be employed—will, according to him, eventually find its way past the middle lobe of the prostate, which indeed sometimes overhangs the vesical end of the urethra to such an extent that the catheter enters from behind forward. The experience of the profession scarcely corroborates this statement. Prostatic retention, impossible to relieve by any form of catheter, has occurred in the hands of the ablest surgeons, and it must be admitted that while impassable prostates, like impermeable strictures, lessen in proportion as years confer added skill, they do occasionally present themselves. It is well to remember in connection with difficulties of catheterization in both urethral stricture and in prostatic enlargement that frequently where small instruments fail to enter large ones go in with great ease.

Cystoscopy.

The first surgeon who undertook to illuminate the internal cavities of the body was a German, Bozzini by name, in 1807. His instrument was, strictly speaking, a urethroscope rather than a cystoscope. It was, however, the first step toward illuminating the inaccessible cavities and

[1] *Brit. Med. Journ.*, Mar. 15, 1890.

channels of the body. Briefly described, the light was obtained from a candle so placed within what might be termed a flat upright case, shaped somewhat like a vase, that the flame came opposite to a strong reflector, from which the rays, through a circular opening in the front of the case, were directed by appropriate tubes to the cavities to be examined. A septum divided this opening, and protected from the direct rays of the candle the observer's eye, which was placed at an opening in the back of the case corresponding to the opening in front. Of course the septum made this latter opening semicircular. This instrument was really nothing more than the rude progenitor of the modern parabolic head-mirrors with electric-light attachments; it never found much favor, and the whole subject of endoscopy seemed forgotten until, twenty years later, it was revived by Ségalas and Fisher, who brought forward their urethoscopes.

On the principle of these urethroscopes in 1853 Desormaux based a cystoscope which appeared to be of a value really practical. Its principle was, in the main, the reflection of the light from an oil lamp at a right angle to the plane of the endoscopic tube. The light was concentrated by means of lenses, and the observer looked down the endoscopic tube through a hole in the centre of the reflector.

All the instruments up to this time had a similarity of construction in that the light was reflected, from without, into the cavity. It was not until 1876 that a thoroughly useful, practical urethroscope was devised by Dr. Max Nitze, now of Berlin. His instrument brought forward two entirely novel principles—namely, the source of light was introduced into the cavity itself, and, secondly, instead of a direct observation of only a small portion of the bladder-wall, a reflection of the field of observation was obtained and enlarged by means of an arrangement of prisms and lenses. This latter principle Nitze says he conceived one day while cleaning the objective of a microscope. Looking obliquely at the surface of the lens to see if there were any dust or scratch on it, he saw in its small area a minute but clear reflection of the landscape in all its details opposite his window. The problem was solved, and he at once undertook to construct his cystoscope.

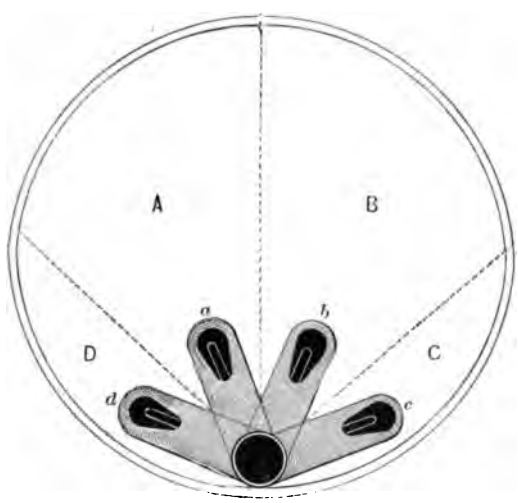
The cystoscope which he planned has been modified in minor points by instrument-makers, but to him belongs credit for the device. It consists of a silver tube bent at the end, like a catheter with a short arm. At the end of this arm, or beak, is a small incandescent electric lamp, enclosed by a metal hood and a window of rock crystal to avoid burning the bladder-walls. Some instruments are provided with two small tubes through which cold water may be made to circulate and thus keep the lamp cool. In the curve of the short arm or at the side or underneath, on the convexity of the curve, is a small window through which the opposite section of the bladder-wall is reflected upon the hypothenuse of a right-angled prism, and thence through the tube to the eye of the observer. The minute inverted image, righted and focused at the ocular end of the instrument by means of two plano-convex lenses, is finally magnified by a lens in the funnel-shaped eye-piece. With this instrument an area of about an inch and a quarter—or, say, the size of a silver dollar—may be seen at one time and by degrees the whole interior of the bladder carefully examined.

In examining the bladder with a cystoscope only glycerin should be used as a lubricant; all oily or greasy substances obscure the rock crystal in front of the reflecting prism; furthermore, it is much easier to clean the instrument thoroughly after using glycerin than after oil or vaseline. The urine, unless perfectly clear, should all be withdrawn with a catheter and the bladder filled with about five fluidounces either of sterile, distilled water, boracic-acid solution, or, as Nitze recommends, a ½ per cent. carbolic-acid solution.

Etherization is very rarely necessary, and in many cases contraindicated where there is a suspicion of extreme infiltration of the bladder-walls.

In some cases, however, hyperæsthesia of the urethra and bladder may cause the patient unnecessary pain, and hence the cystoscopic examination is greatly hindered by the involuntary muscular contractions and spasmodic contortions of the patient. In such cases local anæsthesia is of service, and to produce this, one to two ounces of a 2 per cent. cocaine solution will generally be found quite sufficient and free from danger of cocaine-poisoning. But this solution must come in direct contact with all of the mucous membrane, and in order to ensure this, it is advisable to wash out any pus or superabundant mucus which may be in the bladder, and then inject the cocaine solution, which must be freshly prepared and aseptic. The cocaine is allowed to remain two or three minutes only, and is then entirely withdrawn and the carbolic or other solution injected, sufficient in quantity to distend the organ for examination. Inflating the bladder with air has been performed, but for examination merely, it does not give as satisfactory results as injections of a clear liquid, because pedunculated or papillomatous growths

FIG. 196.



Showing positions of beak of cystoscope (after Nitze).

will cling to the sides of the bladder and appear to be sessile instead of standing out in their true relation.

Manipulation of the Cystoscope.—The patient having been put in the

Trendelenburg position, the pelvis elevated, and the clear liquid injected into the bladder, the instrument is introduced in the same manner as the sound, but in order to be sure that every part of the vesical walls is brought into view a systematic set of motions must be carried out. The first observation is made with the beak pointing upward, and turned as soon as it is beyond the internal sphincter to an angle of about 22½° to the right from the median line of the patient's abdomen. (See Fig. 196, *a*.) This brings into view the anterior portion of the vault of the bladder. The beak is now pushed in farther and farther, the eye-piece at the same time being first depressed and then raised, so that the light follows the curve of the vault until it almost touches the posterior wall. The portion seen by this procedure is a little more than a fourth of the right upper half of the bladder. (See Fig. 196, A.) The beak is now turned to the patient's left about 45°, more or less, but just sufficient to include the margin of the former field of vision, and the instrument slowly withdrawn as far as the internal sphincter, thus bringing into view a section to the left of the median line corresponding to the portion first observed. (See Fig. 196, B.) Again the beak is deflected about 45° to the left and pushed back to the posterior wall, and the lower left-hand segment observed (Fig. 196, C). The instrument is then turned on its longitudinal axis through 135°, so that it is in the same segment as the one just left, only on the right side of the median line, and in like manner it is brought slowly forward (Fig. 196, D).

To bring into view the lower portion of the bladder and the neighborhood of the ureteral outlets and trigonum, the beak is pointed directly downward and the eye-piece of the instrument pressed down so as to bring the prism to a proper distance from the fundus.

The mucous membrane of the healthy bladder when seen through a cystoscope is rosy pink in color and covered with a fine network of capillaries. When the cystoscope is directed toward the vesical trigone, the triangular portion of the bladder lying between the internal urethral orifice and the two openings of the ureters, the mouths of the ureters may be seen opening and discharging the urine in little jets at intervals of about forty to fifty seconds, or possibly not oftener than every three or four minutes, and this, too, under conditions of perfect health. The lower half of the bladder is by far the most important portion, inasmuch as it is there that pathological changes most often begin and calculi or foreign bodies lodge.

In chronic vesical catarrh the mucous membrane is decidedly paler throughout and thickened, the rugæ sometimes thickened in patches to such a degree and so covered with adherent pus that they may be readily mistaken for tumors. In the acute form of catarrh the bladder is exceedingly irritable, and bleeds so easily that cystoscopy is wellnigh impossible, and is, moreover, attended with risk.

Tubercular cystitis cannot be diagnosed positively by means of the cystoscope alone, but after the presence of the tubercle bacillus in the urine has been revealed beyond a doubt by the microscope and by cultivation, and localized hyperæmic spots and sharp ulcerations covered with adherent shreds of necrotic tissue are to be seen through the cystoscope on the mucous membrane, then a diagnosis of tuberculous infiltration is warranted.

Diverticulæ present the appearance of dark spots which cannot be thoroughly illuminated by the incandescent lamp; they are usually associated with trabecular hypertrophy, which through the cystoscope looks like a coarse branching network stretched over the mucous membrane. The most valuable results, however, which the cystoscope yields are early recognitions of tumors, which in their inception may give rise to symptoms of only a mild vesical catarrh with intermittent and slight hemorrhages, whereas by means of the cystoscope the diagnosis is at once manifest and proper operative treatment may be begun.

Meyer[1] has very fully reviewed the relative advantages of the different cystoscopes now in use, and has described the various forms, the *irrigating*, the *operating*, etc., with the first of which it is proposed to get rid of the turbidity of the urine and the obscurity produced by blood, etc., and with the second to make topical applications to the bladder-walls, and even to curette or tear off pedunculated growths or to snare them with a wire écraseur, to extract foreign bodies or small calculi, and to catheterize the ureters, etc.

There is a serious obstacle to any operation performed under such conditions. The hemorrhage from the excision of any growth or from the scraping of an ulcer so quickly clouds the clear fluid injected into the bladder that the cystoscope becomes practically useless. Such operations, therefore, have to be conducted with the bladder inflated with air—a method, as has been noted above, by no means so satisfactory as when the cystoscope is surrounded by fluid, and furthermore there is a constant risk either of burning the mucous membrane or of having the prism obscured by a clot of blood. Nevertheless, topical applications of astringents or other medicaments are quite practicable.

In many points cystoscopy is of great interest, but it can be hardly said to have advanced the surgery of the bladder as far as might be at the first glance imagined. In point of fact, about as accurate a knowledge of the proportions and situation of a growth or foreign body within the bladder-walls may be obtained by means of a sound as by a cystoscope; and furthermore, when the urine contains fragments of a tumor the microscope reveals the nature of that tumor or of a catarrhal condition of the mucous membrane quite as readily as a macroscopic examination through a cystoscope. Beyond the early diagnosis of new growths the greatest service which the cystoscope can render to the surgeon is to demonstrate exactly the source of hæmaturia or pyuria when it is suspected that one of the kidneys is diseased. By observing the outlet of the ureter a knowledge of the individual activity and health of each kidney is obtained, and with this knowledge the surgeon must be guided before performing a nephrectomy. This service is one whereof it would be difficult to exaggerate the value, and many a surgeon will echo this praise who has been saved by the cystoscope from performing a needless nephrectomy.

These instruments, it is needless to say, require constant practice and long experience before they furnish reliable information or become safe surgical tools, but the evidence is quite conclusive that with such practice and experience they are useful additions to our armamentarium. On the other hand, their use by untrained observers is both mischievous

[1] *New York Med. Journ.*, Jan. 30, 1892.

and misleading. Only two years ago[1] Buckston Browne, writing of the diagnosis of the intravesical form of prostatic hypertrophy and of the harmfulness of rough instrumentation in such cases, said: "The electric cystoscope, the use of which is never free from risk, is therefore particularly dangerous in the cases now referred to. In many its employment is impossible or almost impossible, for there are cases in which the shape of the instrument is an absolute bar to its introduction, and in other cases the introduction is attended with so much difficulty that the very limited range of vision is obscured by blood. Several remarkably severe cases of cystitis which I have met with in practice, after endoscopic examination, where the prostate has been enlarged, have created a strong feeling in my mind against the use of this instrument in these cases." With this opinion many surgeons still agree. But by way of making a fair presentation of the case are appended the following conclusions of Meyer:[2] "1. In all obscure reno-bladder diseases cystoscopy has to be practised, if necessary repeatedly, before operative interference for diagnostic purposes is resorted to. 2. There are a number of causes which make cystoscopy impracticable. 3. Cystoscopy is an easy and harmless examination, but its successful employment requires experience. 4. It should be performed as a *dernier ressort* after all other well-known means for making a diagnosis have been exhausted. 5. If properly applied, cystoscopy will generally clear up an obscure disease of the bladder. 6. In most cases we can determine, with the help of electric illumination of the bladder, whether we have to deal with a disease of the bladder or of the kidneys. 7. We can thus find out whether there are two working kidneys, also whether only one of the two kidneys is diseased or both. 8. We shall most probably soon be able, perhaps in the greatest majority of cases, after sufficient personal, practical experience and with the help of proper cystoscopic instruments designed for this purpose, to catheterize the ureters, and thus gather, in a bloodless manner, the urine from each kidney separately. 9. We can make out in certain cases, by observing the character of the jets of urine, especially by timing their frequency and duration at the uretral orifices, whether the other kidney is doing the work for the one which is diseased. 10. These facts will tend to make superfluous, in the majority of cases at least, a preliminary suprapubic or perineal incision for diagnostic purposes, as well as a nephrotomy performed for determining the action of the other (not diseased) kidney. They greatly widen and strengthen our means for making the indication and prognosis of nephrectomy. 11. With the aid of Nitze's newest instrument, the operating cystoscope, we may look forward to being able to carry on intravesical treatment under the direct guidance of our eyes."

V. Dittel[3] records the fact that since 1879 he has made, to his knowledge, six mistakes in endoscopic observation. In the first case horny epithelium was mistaken for scar-tissue; in the second, bleeding mucous membrane for a tumor; in the third, a papilloma situated in a diverticulum was not recognized; in the fourth, he mistook for a phosphatic concretion a tumor covered over by phosphatic material; in the fifth, blood-coagula were mistaken for a polyp; in the sixth, a circum-

[1] *Brit. Med. Journ.*, Mar. 11, 1893. [2] *Loc. cit.*
[3] *Wien. klin. Woch.*, May 16, 1895.

scribed phlegmon was mistaken for a carcinoma. He does not consider that these mistakes detract in the slightest from the value of the methods!

Cystitis.

An exact, and still more an exhaustive, classification of the different forms of cystitis is wellnigh impossible, so little is known of the pathology of this disease. Cystitis, in general terms, is a purulent inflammation of the bladder. It can never be said to be idiopathic; it is always secondary to some disease of the genito-urinary tract or to the specific inflammations, such as tuberculosis. It is invariably due to local, microbic infection. It is possible, but of the rarest occurrence, that cystitis is caused by infection due to micro-organisms or to toxines secreted in the urine or distributed to the substance of the bladder from the general circulation in the course of infectious fevers.

Many more or less successful attempts have been made to classify the different forms of cystitis. Guyon[1] divides them, chiefly according to their etiology, into nine varieties—blennorrhagic, tuberculous, calculous, the cystitis of stricture, of prostatism, of new growths, of the female, painful cystitis, and membranous cystitis. This seems valueless from a practical standpoint, the "cystitis of women," for example, being possibly any one of six of the other varieties. Rovsing proposes to divide it into—1, catarrhal cystitis, caused by the non-pyogenic microbes having the property of decomposing urea; and 2, suppurative, caused by pyogenic microbes, and subdivided into (*a*) ammoniacal and (*b*) acid or tuberculous cystitis. But, as Melchior has shown,[2] catarrhal cystitis is problematical, or certainly very rare, as even the non-pyogenic microbes initiate a purulent cystitis, while the "acid" cystitis is only exceptionally tuberculous. Denys has tried to make a classification based primarily on the bacteriology of the disease, but on comparing seventeen cases reported by Melchior in which the bacterium coli commune was found in pure culture, there are to be observed such radical differences in symptoms, progress, and termination that from a clinical standpoint a common origin would never be suspected. Hallé has tried his hand[3] at a series of classifications which include, all told, forty-three subdivisions.

On the whole, a careful study of all these will reveal that for all practical purposes cystitis may be divided into—1, *acute*, and 2, *chronic*, either of which may be (*a*) *superficial* or (*b*) *interstitial*.

The pathology of the lesions of cystitis is virtually the same as that of the lesions of inflammation of mucous membranes.

The *acute-superficial* cystitis begins with a general congestion and dilatation of the blood-vessels, especially of those in the neighborhood of the neck of the bladder, and, when seen through the cystoscope, the mucous membrane has a generally hyperæmic appearance and in patches is of a brilliant red; here and there may be seen darker spots due to small ecchymoses. After a prolonged inflammation superficial ulcerations also appear here and there, with adherent shreds of pus.

In the *interstitial* form the inflammatory and suppurative processes

[1] *Affections chirurgicales de la Vessie*, p. 613.
[2] *Cystite et Infection urinaire*, Paris, 1895, p. 354.
[3] *Ibid.*, p. 357.

have penetrated between the epithelial layers, and may involve the muscular trabeculæ themselves. In this case the bladder-wall is converted into a suppurating mass; deep ulcerations appear from which dependent shreds of pus and muscular fibres wave out into the urine, and are frequently mistaken for papillomatous growths. The mucous membrane is of the same color as in the superficial type, but it is frequently ribbed by the swollen muscular trabeculæ. In the healing of this variety the loss of substance from suppuration and ulceration causes cicatricial contraction of the bladder, and, frequently, pouches or sacculi are formed between the muscular trabeculæ. These sacculi may persist, and by retaining small quantities of urine favor ammoniacal fermentation, and thereby keep up a constant vesical irritation; or the muscular coats may be so far destroyed that there results an atony or total relaxation of the vesical walls.

Chronic cystitis, frequently spoken of as catarrh of the bladder, is a slightly modified and milder form of the superficial cystitis; all the phenomena of the acute form are present, but, although not nearly as severe, are nevertheless more persistent; added to these is the presence of an abundant muco-purulent discharge from the mucous membrane of the bladder. This discharge sinks to the bottom of the vessel into which the urine is passed, and is so tenacious and stringy that the supernatant urine may be poured off, and then the whole sediment of pus and mucus follows in a mass.

Membranous Cystitis.—A form of cystitis variously described as membranous, desquamative, croupous, exfoliative, diphtheritic-squamous, etc. is attended with the discharge from the urethra of flakes or masses of vesical epithelium, sometimes of the whole thickness of the vesical mucosa.

Cabot[1] has described a case in which a suprapubic cystotomy revealed the presence of a thick membrane which could be detached from the diseased surface of the bladder, and peeled off with the fingers in sheets of one or two square inches' area. It was loosely attached, and after removal left a smooth surface which bled but slightly. It was composed almost entirely of epithelium, but was from fifty to one hundred times as thick as the epithelium normally existing in the bladder-wall, and its nourishment was provided for by papillæ thrown up by the connective tissue below. Cabot compares it with the "pachydermia laryngis" of Virchow, a result of continued irritation. Posner[2] believes it to be a dermoid (or epidermal) change in the mucous membrane of the bladder.

More recently, Stein[3] reports a case with similar symptoms, and gives a résumé of existing knowledge on the subject. Of 50 cases, 45 have occurred in women, 5 in men. The shreds in his case (the patient died probably uræmic, but there was no autopsy) showed, he says, that the mucosa and submucosa had lost their vitality and had come away entire. He discusses the possibility of a mechanical instead of an inflammatory cause for the condition (all the women were pregnant and had retention of urine); but the infrequency of the disease in men, compared with the great number of cases of retention, makes the former theory seem

[1] *Am. Journ. of the Med. Sci.*, Feb., 1891. [2] *Virchow's Archiv*, vol. cxviii., 1889.
[3] *Journ. of Cut. and Gen.-urin. Dis.*, July, 1894.

improbable. Cabot says that in making a diagnosis of this condition, in future cases, the points to be taken into consideration are the chronic character and obstinacy of the cystitis and the presence in the urine of flakes and clumps of horny epithelial cells.

Etiology.—The predisposing causes of cystitis are any pathological changes in the genito-urinary system which tend to induce congestion of the bladder and a weakening of its power to resist the invasion of pyogenic micro-organisms. The morbid conditions which favor cystitis are—1st. Stricture of the membranous urethra, with residual urine; the bladder is never entirely emptied, and is overstrained each time that there is a call for urination. Cystitis, however, is but rarely found as a complication of strictures situated in the pendulous portion of the urethra unless the strictures are very tight and have persisted for a long time. 2d. Enlargement of the prostate, which acts in the same manner as stricture, the retained urine becoming alkaline and irritating from the ammonia set free by the decomposition of the urea. 3d. Acute and chronic posterior urethritis, by causing irritation of the prostatic urethra, excites frequent desire to urinate; this in turn causes frequent congestion of the blood-vessels in the muscular and mucous coats of the bladder. 4th. Paraplegia, when it involves the spinal centres which control the bladder, allows that organ to become over-distended until the point of retention with incontinence is reached. Cystitis may be then set up by the trophic disturbances which naturally follow paraplegia, together with the heightened chances for local infection, which may result either from the spontaneous entrance of microbes through the urethra, which, owing to the constant flow of urine, is rendered freely permeable to pyogenic bacteria, or more probably from accidental infection resulting from the use of septic instruments introduced to draw off the urine. In this case—namely, paraplegia—the lack of sensibility probably precludes active congestion, but the tropic changes so weaken the resistive powers that the organ becomes an easy prey to micro-organisms. 5th. The toxic causes of cystitis are chiefly cantharides and the terebinthinates. These drugs seem to exert a direct irritating influence upon the mucous membrane of the bladder, especially in the prostatic portion, causing violent vesical tenesmus. 6th. Traumatism, by which infection is either directly communicated from the instrument to the lacerated mucous membrane, or else the consecutive changes favor the ammoniacal decomposition of urine, whereby the urine is converted into a favorable medium for the growth of the pyogenic bacteria. In this class of causes may be included fistulas, both vesico-vaginal and vesico-rectal. 7th. Vesical calculus and foreign bodies incite cystitis by lacerating the mucous membrane when they are so situated that the bladder contracts forcibly upon them, or by occluding the internal urethral outlet and thus causing congestion. The mistake is often made of supposing that the cystitis, which is usually associated with calculi, is necessarily secondary to the presence of the stone; in reality, it is frequently the case that the calculus is secondary to cystitis; and certainly it is more than probable that encysted calculi are due to the formation of pouches between the muscular trabeculæ following an attack of interstitial cystitis. 8th. Tumors, and syphilis, and tuberculosis of the bladder are also frequent predisposing causes of cystitis; the two latter, however, are not so frequently met with as the first.

In all the foregoing cases cystitis is, as was stated at the outset, merely a secondary disease incited by local infection in a membrane which has been so modified by pathological changes that it furnishes a medium favorable to the growth and activity of pyogenic organisms. The urine contained in the healthy bladder is aseptic; this has been frequently demonstrated in attempts to form cultures from normal urine. According to Lehman and Richter,[1] it is even bactericidal and distinctly antiseptic; but in all cases of cystitis the urine is loaded with micro-organisms of various forms, and at the same time is often alkaline and ammoniacal; therefore a question of cause or effect at once arises.

The following results were obtained by Rovsing in a study of 30 cases of cystitis: In 26 the urine was ammoniacal and invariably contained bacteria, usually but one species at a time. All of these micro-organisms were cultivated on the usual media except the tubercle bacillus, which in two cases was associated with other species, and they all produced ammoniacal fermentation when pure cultures of them were injected in sterile urine. In 1 case, diagnosed as cystitis, no bacteria were found, and in 3 cases, where the tubercle bacillus was present, as shown by the microscope, cultures could not be obtained.

When pure cultures of these micro-organisms were injected into the healthy bladder of a rabbit, cystitis did not develop; but when the urethra was tied and the urine confined in the bladder until it became ammoniacal, then a purulent cystitis developed on the introduction of the pure cultures of the pyogenic micro-organisms, and a catarrhal cystitis was in like manner produced by the non-pyogenic species. Lündström a year later (1890) succeeded in isolating two species of staphylococcus—namely, staphylococcus ureæ candidus and staphylococcus ureæ liquefaciens—from alkaline urine, in two cases of cystitis. Krögius and Schnitzler have also obtained a bacillus from the urine of cystitis which is known as urobacillus liquefaciens septicus.

Rabbits into whose circulation this micro-organism was injected died in three to eight days, and an intense nephritis was observed at the autopsy in each case. When the pure cultures were injected into the healthy bladder, a violent, purulent cystitis was almost invariably produced. Injections of staphylococcus pyogenes aureus into a healthy bladder failed to produce a similar cystitis, but were found to produce it when artificial retention of urine was produced, or when the vesical wall had been injured in some manner.

These observations seem to show that while there are certain micro-organisms which of themselves will produce a cystitis (the urobacillus liquefaciens septicus), by far the greater part of the pyogenic bacteria, which are to be found in the urine of patients suffering from cystitis, are able to produce a purulent cystitis only when there is some laceration of the vesical mucous membrane, or perhaps when there is merely a very alkaline or ammoniacal urine which is retained for an abnormal length of time in the bladder.

The latest and perhaps the best work done in this direction is that of Melchior, already quoted. (See p. 549.) Since 1891 observers in different parts of the world have demonstrated that the micro-organism described in 1888 by Albarran and Hallé as the "septic bacterium of

[1] *Centralblatt f. Bakteriologie*, 1890, Bd. iii. p. 457.

the bladder" is the bacterium coli commune. In 80 cases of vesical infection it was found to be present in 52. In 36 cases, studied by Melchior in 1894, it was found in 25, and it is interesting to note that in 17 cases, it was found in pure culture in acid and purulent urine. Guyon accepts this as proof that in the majority of cases it is the offending organism, and absolutely rejects the theory of Rovsing that ammoniacal transformation of the urine is the initial and essential condition in the pathogeny of cystitis.

The methods by which this and other micro-organisms gain access to the bladder are various. First, they may be introduced from without, during catheterization, or sounding for calculus, etc.; and this is more likely to occur for the reason that these operations are rarely performed unless there exists exactly the condition which has been found to be favorable to the growth of the pyogenic organisms—namely, retained urine, irritation, and perhaps slight laceration of the mucous membrane from urinary calculi, foreign bodies, etc. Secondly, they may make their way to the bladder through the urethra before the introduction of any instrument. When there is retention of urine with incontinence, there is a constant stream of urine passing slowly through the urethra, and in this stream the bacteria can readily make their way to the bladder, where they at once find a medium suitable for their growth. A similar condition is found in cases where a cystitis follows a gonorrhœa. The gonorrhœal inflammation creeps steadily back until the prostatic urethra is involved, and then the inflammation is practically in the bladder, to which the pyogenic bacteria of cystitis may easily gain access through the outpouring stream of gonorrhœal pus. And, thirdly, infection may take place indirectly through the circulation in the course of the infectious fevers, but it is very rare.

Melchior's conclusions,[1] warmly endorsed in the main by Guyon, may be added to this brief résumé of one of the most important subjects connected with genito-urinary surgery: 1. Every cystitis (with the exception of the rare instance in which it arises from chemical substances) is of microbic origin. 2. Usually there is found in the urine of cystitis a pure culture of a single species, generally in enormous quantities. 3. The bacillus found most frequently in cystitis and described by different authors under different names is identical with the ordinary intestinal parasite or bacterium coli commune; it is pyogenic and infectious and of variable virulence. 4. In the urethra, pathogenic bacteria are frequently found, which, when introduced into the bladder, may cause cystitis. 5. A microbe alone does not produce cystitis. We are, however, familiar with one bacterium, the proteus of Hauser, which merely by its introduction into the bladder is able to determine a cystitis by virtue of its property of decomposing urea. 6. A microbe can only cause a cystitis when the bladder has previously been rendered vulnerable to infection by different predisposing agents, especially retention or traumatism. 7. Retention of urine, and also traumatism, are of themselves unable to provoke a cystitis. Microbic infection is always the determining cause. 8. The different varieties of cystitis depend upon the pre-existing lesions, the character of the nutritive medium, and also upon differences in the virulent and other qualities of the bacteria. 9. In every case of cystitis

[1] *Op. cit.*, p. 371.

pus is found in the urine, but in very different quantities; the existence of a catarrhal cystitis is doubtful. Even non-pyogenic microbes of the cellular tissue may provoke suppuration in the bladder. 10. Ammoniacal urine may be a necessary condition for the establishment of a cystitis in a particular case, but it is often only an insignificant phenomenon which supervenes during the course of the disease or remains altogether absent. 11. Aside from the bacillus tuberculosis, acid cystitis may be due to the bacteria coli commune, to the streptococcus pyogenes, and to other rarer micro-organisms (the gonococcus of Neisser, the typhoid bacillus, etc.). If urine in a case of cystitis is taken with aseptic precautions and gives no cultures when inoculated into ordinary nutritive media, the case is in all probability one of tuberculosis. 12. There are true blennorrhagic forms of cystitis caused by the gonococcus of Neisser. 13. Urinary fever arises in part from the entrance of urinary microbes into the blood, and without doubt more frequently from an absorption of the dissolved bacterial toxines. 14. In order to prevent a cystitis, it is not sufficient to render the urethral orifice perfectly aseptic; it is necessary also to use boric-acid irrigations of the urethra itself. 15. In the local treatment of cystitis the nitrate of silver is the sovereign remedy.

Symptoms.—Frequency and urgency of urination, together with pain more marked as the last few drops are forced out, and the constant presence of pus in the urine, are the cardinal symptoms of all forms of cystitis. In addition to these, there is almost always vesical tenesmus and straining during the act of micturition, so violent that it often produces hemorrhoids. The first few drops of urine may be so irritating to the urethral mucous membrane that there will be a spasm of the sphincters and only a small portion of urine escape at a time. The bladder becomes either much more distended and painful under pressure above the pubes, or, more often, the irritation is so great that it will hold but a few drachms of urine at a time, and hence the acts of urination become so frequent as almost to amount to incontinence. The pain is felt most during micturition or just before it, and the discharge of a drachm or two of urine which is always high-colored affords scarcely any relief to the sensation of heaviness in the hypogastrium or perineum. Sharp, darting pain just at the close of micturition is most characteristic of the cystitis following gonorrhœa or of the cystitis following prostatitis; owing to the contraction of the accelerator urinæ muscle a few drops of blood are quite frequently squeezed out at the close of urination. Pus is a constant sign of cystitis; during the onset of the disease it is hardly visible to the naked eye, but the amount rapidly increases until it gives the urine a uniform milky appearance; and finally, when the urine becomes highly alkaline, the pus is changed to a thick, tenacious mass which clings to the bladder-walls and to the vessel in which the urine is passed. With the three-glass test the presence of a greater amount of pus in the urine passed in the first glass shows that the inflammation is chiefly confined to the neighborhood of the prostatic urethra and the internal urethral orifice, but it is not possible to tell definitely from the amount of pus in the two other glasses what portion of the vesical mucous membrane is most affected, because the pus would naturally sink to the lowest part of the bladder whether it came from

the sides or top, and be expelled with the last portion of urine. Blood in small quantities is almost a constant symptom, and in some instances, when the disease has been persistently severe and there are ulcerations of the mucous membrane, hemorrhages of no little severity may take place. Small admixtures of blood can scarcely be seen in the purulent urine, but when the blood has oozed into the bladder and been retained there for a length of time, it is almost black in color and sinks to the bottom of the vessel into which the urine is passed. Then, again, the whole quantity of urine may be tinged with blood, or the hemorrhage may occur only just at the close of micturition and the blood be bright red in color. This hemorrhage in acute cystitis is due to the forcible contraction of the bladder-walls upon each other. When a tumor of the bladder exists, blood is found in all periods of micturition; both dilatation and contraction of the bladder cause hemorrhage. When a calculus has been formed, it may be noticed that the general amount of blood in the urine is increased after motion, and there is also a greater quantity passed with the last portion of urine. When the congested bladder-walls contract on the calculus they are lacerated, and thus a few drops of blood are squeezed out, usually from the bas-fond of the bladder. Albumin in the urine of cystitis is due to the presence of blood when there is no associated renal disease.

Diagnosis.—The diagnosis of cystitis may at first glance seem to be easy, but frequently disorders of the urinary tract are diagnosed as cystitis merely because one or two leading symptoms are present, such as frequent micturition and pus in the urine. It must be borne in mind that almost any inflammation of the urinary tract will cause frequency of micturition, and it is by no means a pathognomonic symptom of cystitis to find pus in the urine; pyuria is undoubtedly a most important symptom, but its importance chiefly lies in the determination of the portion of the genito-urinary tract from which pus comes, and this can be most easily accomplished by having the patient pass his urine in three separate portions into three glasses, alluded to above as the "three-glass test." Roughly stated, the first glass may be said to contain the washings from the urethra, and the second, to show the general condition of the urine, while the contents of the last glass are usually derived from the lower part of the bladder, where pus has settled. If there should happen to be also any spot of ulceration upon the walls of the bladder, the forcible action of the detrusor muscle would cause the appearance of blood with the last portion of urine.

In this manner a purulent urethritis is indicated from pus present in the first portion of urine and none in the two other portions. In cystitis the pus is present in all three portions, but is most abundant in the last. In diseases of the kidneys the pus is more evenly distributed throughout the urine, and is not quite so profuse, except perhaps in cases of pyelitis or of inflammation of the ureters. In pyelitis and inflammation of the ureters, pus in considerable quantities is found in the urine, but it forms a more flocculent and slimy mass than in cystitis; under the microscope this mass is found to consist of a dense aggregation of leucocytes. These distinctions as to the nature of urinary sediments are, however, more or less variable and cannot be altogether depended upon.

Large epithelial cells from the mucous membrane of the bladder are

also present in great numbers in cystitis, and are usually covered with micro-organisms, either short bacilli or micrococci in clusters.

Pain during micturition is not a characteristic symptom of cystitis; it also accompanies the act of emptying the bladder in urethritis and prostatitis, and sometimes in calculous pyelitis, and in all of these diseases there is pyuria. The locality of the pain is a valuable point of guidance. In urethritis the pain is felt all along the urethra or else only in the pendulous portion, and is a stinging, smarting, or burning pain. In prostatitis it is deep within the urethra, and is associated with a sharp throb as the last drop of urine is expelled, and often a drop or two of blood follows this last drop. In renal calculus the pain is felt in the groin and down the thighs, and is described as an aching pain like a strain. In cystitis the pain is felt in the bladder and hypogastric region, and is slightly relieved after micturition; it is exceedingly severe during micturition in cases where the cystitis is secondary to urethral stricture or where the inflammation at the neck of the bladder is of high grade. In such cases vesical tenesmus and straining are marked symptoms. When calculus is associated with cystitis, pain is also felt on the under surface of the penis near the meatus at the moment when the stream is stopped by the stone falling over the internal urethral orifice.

Thus we have, as guiding-points in forming a diagnosis of cystitis, frequency and urgency of urination; pain before and during the act, felt in the region of the bladder and over the hypogastrium, and somewhat relieved when the bladder is emptied; pyuria, the pus being present in all three portions of the urine; the urine, at first acid, often becomes ammoniacal and alkaline; microscopically it contains many bacteria and frequently considerable blood; and lastly, we have the anamnesis, which almost in every case shows that there has been either an overdistention of the bladder due to stricture of long standing or that septic instruments have been introduced into the viscus.

Prognosis.—From acute cystitis there is often apparently a complete recovery; oftener, however, some infection of the mucosa remains, to be reawakened whenever the normal emptying of the bladder is interfered with, or when sexual or alcoholic excess or intercurrent disease causes pelvic congestion and irritation. Of the 35 cases in Melchior's series, 8 died, 10 left the hospital uncured, and 17 were pronounced "cured." But of the whole number, in only 7 (20 per cent.) was there sterile urine when dismissed, only this proportion can be said to have been entirely cured. There can be no doubt that the cases which we discharge both in hospital and private practice as "well," and which leave us without clinical symptoms, but with infected bladders, often relapse. A small proportion of them may win their way back to permanent health; a larger number, exposed to obstructive or inflammatory conditions, suffer again and again with attacks of cystitis.

Treatment.—*Prophylactic.*—In point of fact, the prevention of cystitis is the most important detail in the every-day work of the genito-urinary surgeon. It must never be absent from his mind that the very conditions which call for his intervention are those which favor the development of cystitis, and, moreover, are those in which cystitis is most dangerous. As Bouchard says: "What renders the development of an infectious disease possible is not the accidental meeting of

a man and a microbe;" the soil must be prepared, and in these cases this has been done in advance. The chief difficulty to be overcome in the avoidance of the introduction into this soil of the germs of disease arises from the fact that it is almost or quite impossible to render the urethra fully and absolutely aseptic.[1] Full irrigation with 40 per cent. boric-acid solution will, largely through its mechanical action and partly through its feeble bactericidal power, free the urethra so that a sound may be introduced sterile into the bladder. The urethral orifice may be rendered really aseptic by washings and soakings with a 3 per cent. carbolic solution and afterward with boric acid. Sterilization of the urine in doubtful cases may be partially accomplished as a preliminary to vesical examination by the administration of boric acid or salol internally. When time permitted I have long been in the habit of preparing my patients in this manner, but as the pathogeny of the infective bladder and kidney diseases is being unfolded I am becoming more and more impressed with the necessity for it. A terse and practical description recently given by Keyes[2] of antiseptic details in the use of the catheter and other urethro-vesical instruments will serve as a good general guide, although there are great differences among surgeons as to the methods of attaining the desired end. I have modified it slightly in accordance with my own preferences: If a rubber catheter is used, it is kept constantly in a 1 : 4000 bichloride solution, and washed in very hot water after each use. Simple glycerin is the lubricant. The anterior urethra is flushed as the catheter enters for the first time, and all the way in through the membranous and prostatic urethra, with a 1 : 200 carbolic in 1 : 4000 sublimate solution. The urine is to be entirely but very slowly drawn off (watching the pulse), the patient being recumbent. The bladder is then to be immediately washed out with a 6 per cent. salt solution (heaping tablespoonful to the quart); this is to be drawn off, and such quantity of a weaker salt solution (teaspoonful to the quart) introduced and left in as the surgeon may think best.

With such simple precautions catheter-life may be safely instituted in a prostatic case, for example, without implicating the bladder or kidneys, and often (unless the bar at the vesical neck bleed from being bruised) with what might be fairly termed an absence of pus in the urine; and this goes on until the tissues become hardened, when any ordinary catheter may be safely used if simply kept clean.

When an operation is to be performed the urine is usually already purulent. In this instance it is better to flush out the entire urethra and bladder, before the operation, with a salicylic-acid solution, followed by a 1 : 8000 bichloride and 1 : 200 carbolic solution (this after the anæsthetic has been administered), and to follow the operation by a flushing out with a nitrate-of-silver solution, 1 : 1000; finally, and in subsequent washings for cleanliness, using about a 6 per cent. solution of common salt in hot water, and such strengths of mercuric or argentic irrigation as seem called for.

Thiersch's solution and boric acid are difficult to prepare promptly. If the Thiersch solution be made on the spot (salicylic acid, ʒss; boric acid, ʒiiiss, in powder, added to a quart of hot water, is near enough to

[1] Petit and Wassermann, *Ann. des Mal. des. Org. Gen.-urin.*, 1891, p. 500.
[2] *Loc. cit.*

the formula), it dissolves slowly. If the cold solution has to be heated, it is troublesome. Boric acid also dissolves slowly, and bacteriological experiments show that it is no more effective in killing germs than is salt and water. Salt dissolves at once, and it is more cleansing than simple water; salicylic acid, besides being an admirable germicide, has the extra advantage, first pointed out by Bryson of St. Louis, of penetrating farther and cutting deeper into the thick cohesive muco-pus of chronic catarrhal inflammation than any other substance. Therefore, it is well to have made a solution of salicylic acid in alcohol, eight grains to the ounce. One half-grain salicylic acid to the ounce is as effective a germicide as Thiersch's solution; consequently, by adding one ounce of the alcoholic salicylic acid solution to a pint of hot water we have a mixture promptly made and as effective as that of Thiersch.

In the treatment of the cystitis itself there are two broad indications—namely, first, to secure absolute rest, including the prevention of vesical tenesmus and the avoidance of everything which tends to excite congestion of the bladder; and, secondly, the rendering of the bladder-walls and the urine unsuitable media for the growth of micro-organisms. With regard to rest, this is best gained, of course, by placing the patient in bed, and during the acute stage having the pelvis elevated slightly and the knees bent over a pillow in order to relax the abdominal muscles and relieve the pressure over the bladder. Elevation of the pelvis in a measure tends also to displace the intestines upward, thus preventing them from pressing down upon the inflamed organ; and to prevent passive congestion the bowels should be kept freely opened either by mild laxatives or by an enema of hot water. In many cases these will be sufficient to relieve the pain and the constant desire to pass water, but in the majority of cases the pain and tenesmus must be overcome by the free use of anodynes, especially opium and its alkaloids. The most effective mode of administration is by suppository; the local sedation is greater, and the chances of deranging the digestive apparatus are reduced. While opium is being used an enema of hot water should be always given before defecation, and a dose of Carlsbad or Epsom salts administered in the morning to control the constipation. Hot hip-baths and cloths wrung out of hot water and applied over the region of the bladder and to the perineum are in many cases of benefit in alleviating the pain. The use of local anæsthetics, such as cocaine, is of little value in cases of purulent cystitis due to traumatism or to over-straining, but in the tenesmus accompanying cystitis due to poisoning by cantharides, which is the nearest approach to an idiopathic form, a local application of about fifteen drops of a 1 per cent. solution of the hydrochlorate of cocaine to the prostatic urethra and to the neck of the bladder will often give perfect relief in one or two minutes; when the anæsthetic effect wears off, which will be possibly in about three hours, another injection of about ten drops may be given. The monobromide of camphor, which is generally recommended to control tenesmus caused by cantharides, may fail completely, and then it is well to try the anæsthetic effect of cocaine.

The next step is to render the urine bland and unirritating and at the same time antiseptic; this may be accomplished by certain drugs which influence the urine as it is secreted by the kidneys, so that when

it enters the bladder it is not at once converted into an alkaline ammoniacal medium for the growth of pyogenic bacteria. Since the urea is the substance which in decomposing gives off ammonia, let the excretion of that substance be reduced to a minimum. This is accomplished largely by rest in bed; exercise, it has been proved, increases the elimination of urea. Furthermore, the diet must be restricted; meat is to be avoided and an exclusively milk diet maintained, at least during the acute attack. In chronic cases, the diet may be less restricted, but all highly-seasoned food forbidden. The natural mineral waters act as excellent diluents to the urine and may be taken with great advantage between meals. Saline diuretics, among which the citrate of potassium holds first place, should be given in quantity just sufficient to keep the urine as nearly neutral in reaction as possible. Among the other drugs for the most part employed empirically, but all frequently useful, are balsam of copaiba, buchu, pareira, etc. To render the urine antiseptic salol, boric acid, and benzoic acid, in five-grain doses, are to be recommended, and are of undoubted service in the great majority of cases. In some patients they cannot be given in sufficiently large doses to give the urine a true germicidal property without at the same time seriously disturbing the digestion.

In the chronic cystitis of prostatics Reginald Harrison recommends sodium hyposulphite in half-drachm doses given in a little beef-tea or beef-juice. He says: "It is not pleasant to take, but it will often remove pus from urine."[1]

In most cases if we remove the direct exciting cause and as far as possible put the bladder at rest and dilute the urine so that ammoniacal fermentation does not easily take place, the cystitis rapidly disappears. If all these measures fail, it will become necessary to resort to local treatment of the diseased mucous membrane, which is accomplished by means of instillations—*i. e.* solutions applied to the prostatic urethra by means of a deep urethral syringe and by intravesical injections. Instillations act directly upon the prostatic urethra and neck of the bladder, where the inflammation is usually most intense, and, although at first they seem to aggravate the tenesmus, this aggravation soon passes off. Silver nitrate in the maximum strength of five grains to the ounce, introduced when the bladder is empty, often proves of great benefit. It is well to begin with one-half grain or one grain to the ounce. Intravesical injections should be employed only in cases where the bladder is capable of holding at least four ounces without producing great pain and urgency of urination. Only soft-rubber catheters should be used, and even then with great gentleness; the introduction of metallic two-way catheters is a decided mistake and does more harm than good. If the bladder contains tenacious purulent urine, it is best to wash it out with sterilized or distilled water before the introduction of other injections for local action. To wash out an inflamed bladder will cause considerable pain, and probably provoke greater irritation unless the operation is conducted with the utmost gentleness; the bladder should never be distended with water or other fluid to an extent that causes an urgent desire to evacuate it; the washing out can be better accomplished and will cause the least possible pain if not more than two ounces be injected at

[1] *Provincial Med. Journ.*, Aug., 1893.

a time. A soft-rubber catheter having been inserted as far as the bulbo-membranous junction of the urethra, the nozzle of a fountain syringe should be attached and the sterilized water allowed to flow in and again flow out alongside of the catheter in order to wash out the urethra. The catheter is then passed into the bladder, and about an ounce and a half is injected; this is then drawn off, and will be found to be thick and full of pus-shreds; the nozzle is again attached and a second ounce and a half injected and drawn off, and so on until the washings come away clean. This method of washing with small injections is not only less apt to cause pain than if large quantities are injected at once, but it is often most soothing and relieving. After the bladder has been thus washed out it may be irrigated in the same manner with one of the following solutions: nitrate of silver, ¼ to 2 per cent.; permanganate of potassium, 1 : 2000; boric acid, 15–20 grains to the ounce; creolin, 1 or 5 per cent.; corrosive sublimate, 1 : 15,000 or 1 : 20,000; carbolic acid, 1 : 500. It seems worth while to emphasize the especial value of nitrate of silver among these various preparations used for bladder-irrigation. It rests on a well-established foundation of experimental and clinical evidence. Guiard (1883), Rovsing (1889), and Melchior (1895) have, in the pursuit of different aims and with different lines of thought, abundantly demonstrated its superiority to most other antiseptics used for this purpose. Guiard proved its sterilizing action in test-tubes containing foul urine. Rovsing had the same results in testing pure cultures of certain pyogenic microbes which he believed to be the most common causes of cystitis; he also showed the property of penetration of the tissues possessed by the silver salts, which so much enhances their bactericidal value. Melchior investigated its effects upon the bacterium coli commune, the streptococcus pyogenes, and the proteus of Hauser. All three concur in placing it in the front rank, and in bladder cases very far beyond the majority of other antiseptics in practical usefulness. My own experience coincides with that of the many (Guyon, Dittel, Finger, Fenwick) who have found it the mainstay in chronic cystitis, and although I occasionally have to abandon it on account of the pain excited by even the weakest solution, I never fail to try it persistently, and in the majority of cases with good results.

If all these methods do not alleviate the symptoms, and the patient's strength is rapidly failing, and symptoms of septic absorption appear, it will be necessary to perform a perineal or a suprapubic cystotomy. Drainage through the suprapubic opening is the operation of choice in cases where the cystitis is dependent upon the presence of a foreign body or of intravesical growths necessitating an operation for their removal. The perineal method is to be preferred in the majority of cases, and consists of entering the bladder through the membranous portion of the urethra. An important factor of success in the operation is thoroughly to dilate the prostatic urethra and by forcible stretching temporarily to paralyze the muscles at the internal meatus. The benefit of this method has been lately emphasized by Dr. Bangs of New York in an article on perineal lithotrity. The drainage-tube should be of large calibre and of sufficient resistance to bear the pressure without flattening. Iodoform gauze should be packed in the wound, and, to avoid infection from the air, it is advisable to have the free end of the tube submerged in a vessel

containing some antiseptic solution, into which the urine is siphoned. By means of this perineal opening the bladder is put completely at rest, and, furthermore, it is easier to keep it thoroughly clean and also to irrigate with the above-mentioned solutions.

It is a mistake to suppose that cystitis is a contraindication to operation. With proper aseptic methods and antiseptic precautions it is perfectly possible to operate without thereby, of necessity, increasing the intensity of the cystitis; in many cases to effect a complete cure operation is essential.

Vesical Tuberculosis.

Tuberculosis of the bladder is one of the most distressing and hopeless of all diseases of the urinary tract. It is found more frequently in males than in females, and is a disease of early and middle life, occurring chiefly between the ages of fifteen and forty; it has been observed, however, in children of four or five years old, and Tapret noted a case occurring in a man at the extreme age of ninety-seven. It is usually associated with tuberculosis of the seminal vesicles and of the prostate.

The predisposing causes have been found to be a general tuberculous tendency, often inherited, together with an infectious cystitis, gonorrhœal or otherwise, which serves to produce a favorable ground for the development of the tubercle bacillus, infection with which is always the direct exciting cause. This infection may take place directly through the urethra or indirectly through the ureter from renal tuberculosis. Fournier is of the opinion that direct inoculation can take place from woman to man during coitus by the introduction of tuberculous mucus from the vagina into the male urethra and thence to the bladder. Many surgeons believe that the most common means of inoculation is through the ureter in the course of renal tuberculosis. It is not possible to decide from an autopsy whether the process began in the bladder or in the kidney when both are affected, even if the kidney shows signs of much greater infiltration and destruction. It is a well-known fact that a tubercular process in the kidney is decidedly less violent than when the bladder is attacked, and that the vesical symptoms may long antedate any positive evidences of renal tuberculosis. Guyon points out that in the earliest stages of vesical tuberculosis, when it appears to be primary in the bladder, the prostate and seminal vesicles may be affected and nodosities distinctly felt in these structures, although no symptoms indicating the implication of these organs have manifested themselves.

Councilman[1] believes that in uro-genital tuberculosis the most common seat of the primary disease is the epididymis. He says: "It may be confined to this, or the testicle may be affected by continuity. The epididymis is converted into a more or less firm, caseous mass. From this the disease extends along the vas deferens, which becomes enlarged, and on section the interior is found to be lined with a whitish caseous tissue. In both the vas deferens and epididymis the seat of the disease is primarily in the epithelium, and takes the form of a tuberculous inflammation. The seminal vesicles on the same side become affected in most cases, or they may be passed by and the disease appear in the pros-

[1] Vol. I. of this work, p. 246.

tate or bladder. Up to this point it is easy to see how the infection has taken place: the extension has been in the direction of the secretion, and the bacilli could be carried along with the secretion. From the bladder the extension is in a direction opposite to the flow of the secretion. With or without any involvement of the ureter infection of the pelvis of the kidney and of the adjoining kidney-tissue takes place. It is probable that the bacilli find suitable conditions for growth in the ureter, and grow along the walls, just as on the surface of a solid medium, until the pelvis of the kidney is reached. There is no other way for infection to take place from the bladder to the kidney than along the ureter. There is no lymphatic or vascular connection. The proof that this is the usual route of infection in genito-urinary tuberculosis is shown by the certainty with which the disease can be traced step by step, and the extreme rarity of the disease in females as compared with males. In some cases the disease appears to be primary in the kidney, and the infection may take place in the opposite direction."

On the other hand, Warren[1] says: "The question is often discussed as to the direction the disease takes in the genito-urinary organs. Does it ascend from the urethra or the testicle to the kidney? or does it originate in the kidney and descend through the uro-genital tract? Rokitansky and other more recent authorities are of the opinion that the disease ascends from the testicle, but Virchow takes the opposite view. Tubercular disease of the urinary organs is rarely found in connection with disease of the testicle. Tuberculosis of the testicle, although it is rare as a purely primary disease, is often found without tuberculosis of other portions of the genito-urinary apparatus. Primary affection of the kidney, with subsequent disease of the testicle, is not so rare as it is usually supposed to be. Nevertheless, the usual mode of progression is an ascending one. That is, the disease is transmitted from the testicle to the cord, and subsequently to the prostate. From this point it may be transmitted to the bladder and the kidneys, but this is by no means frequent."

Melchior[2] details a case in which the clinical and post-mortem evidence showed conclusively that the disease began in the kidney, and that the bladder had for a long time resisted infection by urine filled with bacilli. Baumgarten[3] and others have shown experimentally that this is quite possible, the healthy bladder of rabbits remaining uninfected even after the injection of large quantities of tubercle bacilli. Melchior contests strongly Rovsing's opinion[4] that the differential diagnosis between primitive vesical tuberculosis and the same disease secondary to renal tuberculosis is easy, as "the progressive ulceration of the ureters always manifests itself by pronounced symptoms, especially by marked pain along the course of the ureters." The case mentioned above and many others show that this statement is not correct, and that, so far from being able to say with certainty in many cases that a given case of vesical tuberculosis is primary, we must almost always remain in doubt as to the presence or absence of the disease in the kidneys. Its existence there may be easily demonstrable, but it may be also present, and to a formidable extent, without one single diagnostic symptom having shown itself.

[1] *Surgical Pathology and Therapeutics*, p. 577.
[2] *Op. cit.*, p. 324.
[3] *Jahresbericht*, 1887, p. 202.
[4] *Loc. cit.*, p. 100.

Hallé (who has edited and annotated Melchior's work) says: "The absolute absence of symptoms in the tubercular lesions of the kidney and ureter cannot be too strongly emphasized. The only indications are often failure of the general health and an indolent bacillary pyuria, and even this may be lacking if the ureter has become speedily obliterated. These diseases, therefore, at their beginning, and even up to an advanced stage, are often not recognized. It is only when the bladder becomes affected and the pains of cystitis or cystalgia manifest themselves that medical advice is sought. Often even then the attention of the physician is entirely directed to the dominating painful vesical symptoms, and he is apt to attribute to the bladder alone phenomena which arise from renal lesions. Bearing these facts in mind, it will be found that in many patients the urinary tuberculosis, considered as primarily vesical or prostatic, and classed among the ascending tuberculoses, has in reality begun insidiously in the kidney. Autopsies support this view. In many cases of widespread tuberculosis of the urinary tract it is possible to demonstrate the greater age of the renal lesions." Hallé concludes: "In a word, I am of the opinion that urinary tuberculosis begins in the kidney oftener than clinical observation would lead us to suspect, and that it is especially a manifestation of *general* tuberculous infection localizing itself in the kidney, which it reaches by way of the circulation."

But, whether we accept the view of ascending or that of descending infection in the majority of instances, another mode of origin remains to be considered. Two of Melchior's cases gave pure cultures of the bacillus tuberculosis, in one of them scarcely a month after the onset of the first symptoms. In neither of them was there the slightest evidence of renal disease. Daily examinations of the urine did not give any ground for such a supposition, nor was there involvement of testicle, epididymis, or seminal vesicles. By the method of exclusion in these and similar cases we can arrive at a diagnosis of hæmatogenic cystitis. If it be asked whether such an explanation is in accord with our general knowledge of the development of other tuberculous affections, the answer must be in the affirmative. The observations of Weigert, Heller, Weichselbaum, and others have shown that the blood is one of the principal channels by which tuberculosis is propagated throughout the system. Pathological anatomy equally tends to confirm this theory, as in tuberculous cystitis the initial changes are found to be grayish miliary tubercles situated on the superficial layer of the epithelium. Ulceration is always a later stage. Clado, having previously wounded the vesical mucosa of a rabbit, gave it a subcutaneous injection of tubercle bacilli. It developed vesical tuberculosis.

Pathological Anatomy.—The perivesical region is infiltrated with a yellow fibro-liponatous degeneration; the bladder is small and shrivelled, the walls thickened and hardened. The mucous membrane is ecchymotic in spots and covered with irregular fungoid rugæ. The lesions are usually concentrated in the vesical trigone. Granulations can rarely be seen, but when visible they appear like fine gray dots, sometimes confluent, but never in such masses as are seen in the kidney. Ulcerations, either single or multiple, are found in the mucous membrane. Tapret describes them as strongly resembling herpetic ulcerations, while

Parrot regards them as more like small-pox pustules. Their edges are irregularly excavated, their base a greenish-gray covered with thick pus. In depth they are very variable, sometimes only invading the mucous membrane, and again they may even perforate the bladder-walls and produce perivesical abscesses or fistulas opening into the rectum, vagina, or hypogastrium; fistulas, however, are rare. Microscopically, it is seen that the tubercular granulations arise in the superficial layers of the mucous membrane, and in these lesions the tubercle bacillus and many septic bacteria will be found.

Symptoms.—The onset of the disease is most insidious and misleading. No other symptom may be observable than a somewhat frequent urination, chiefly after meals and during the night. The urine is clear and limpid, is passed every hour or so, and the frequency, which in children may be attributed to nocturnal incontinency, is aggravated by the dorsal decubitus. The characteristic of this first period is the limpidity of the urine.

Hæmaturia in many cases is a prodromal symptom; it is usually slight, comes on spontaneously, and may consist merely of a few drops of blood at the close of urination, while the whole quantity of urine is faintly tinged with blood. It ceases likewise spontaneously, and may not reappear for many days or even weeks, and becomes less and less as the disease advances. It is never as profuse as in cases of vesical tumor.

Pain.—The onset of pain is an indication that cystitis has been aroused, possibly by catheterization, or more probably spontaneously. When once this symptom of pain in the bladder has started in the course of vesical tuberculosis, it becomes one of the most constant and distressing features. The patient has hardly any relief night or day from the urgent desire to pass urine; he may have attacks of straining every five or ten minutes, and the pain is felt at all stages of urination. In the hope of possible relief from this suffering any operation is hailed with joy on the part of the patient. It may also happen, on the other hand, that an advanced stage of vesical tuberculosis is reached before the slightest symptom of pain manifests itself.

Retention of urine occasionally results from inflammatory obstruction of the internal urethral orifice, and again *true incontinence* may arise from destruction of the neck of the bladder by the tuberculous process.

Pus is present only when a cystitis has been established; in the initial stages of the disease, as has been said, the urine is remarkably limpid or at most faintly tinged with blood. The tubercle bacillus may be detected in the sediment in the urine by the usual methods of straining, as practised for the examination of sputum, or by centrifugation, but it is somewhat difficult. The best methods of demonstrating its presence are by cultivation on artificial media and by inoculation of the lower animals.

In the female a painful zone of ulcerations may be sometimes seen at the meatus urinarius, extending thence up the urethra. The cystoscopic appearance of the tuberculous bladder has been described as follows by Fenwick,[1] who at the same time gives warning that these appearances are frequently mistaken for vesical tumor: "Heaped-up projections of the swollen mucous membrane, having the appearance of a cock's comb, mimic the stunted papillary fibromata; short and tag-like streamers of

[1] *Brit. Med. Journ.*, May 4, 1889.

necrotic tissue resemble the necrotic villi or shreddy ulcerations of neoplasmic surfaces; while the large tabs of infiltrated mucous membrane receding from an ulcer resemble polypi or subvilloid growths."

The treatment consists first in building up the general health by tonics, cod-liver oil, mild exercise in the open air when possible, and also in the internal administration of such remedies as buchu, boric acid, oil of sandal-wood, and cubebs, etc. to allay the cystitis and render the urine bland. Pain, when present, must be alleviated with opium and its alkaloids. Guyon employed as an irrigation a solution of bichloride of mercury of the maximum strength of 1 : 1000. He is, however, not a strong advocate of its use, as it sometimes causes considerable irritation, but in a certain percentage of cases it checks the disease and alleviates the pain. Bryson[1] thinks that such solutions are not only excessively irritating to the mucous membrane, but also tend to spread the disease. Surgical treatment is of little avail, but when the urgency and pain of urination are severe a merely palliative operation may be performed to establish permanent drainage of the bladder. Suprapubic cystotomy is to be preferred to perineal, since by the former the bladder is opened at a point somewhat removed from the most active portion of the tuberculous process. A perineal wound is very apt to become infected, whereby troublesome fistulas are formed.

The bladder should be frequently irrigated and washed clean by means of copious injections of warm sterilized water through the suprapubic opening. By these means the process is occasionally checked, and the patient may for some time longer drag out a miserable existence, but there is a constant risk that the abdominal wound may reulcerate and break down, and an abdominal hernia be the outcome. On the whole, the best results follow general antitubercular treatment.

Calculus of the Bladder.

Vesical calculus, or "stone in the bladder," is, strictly speaking, a condition in which the solid constituents of the urine have formed into concretions of such a size that they either cannot, or, owing to their gravitation, do not, pass out through the normal passages, but remain in the bladder and require instrumental interference to remove them. Sir Henry Thompson has found fault with the statistics on this subject, because surgeons have described as operations for calculi those operations which were performed for the removal of concretions weighing less than twenty grains; such small deposits, he maintains, should be really classed as gravel.[2] This distinction seems open to criticism as arbitrary, inasmuch as for the removal of this "gravel" the patient has to be subjected to the same operation as for concretions of greater weight. Would it not be more befitting to class as "stones" concretions which cannot, by the physiological contraction of the bladder, be expelled through the normal urethral outlet? It is the popular name of "stone" which, it is submitted, misleads; stones in common parlance are both larger and heavier than gravel; and gravel, by the same rule, is larger than sand or brick-dust. If we are to classify, as Sir Henry Thompson seems to

[1] *Morrow's System of Genito-urinary Diseases*, 1893, p. 868.
[2] *Lancet*, Mar. 15, 1890.

think we should, according to weight, the heaviest stones extracted from the bladder, in comparison with gravel, might not improperly be denominated "urinary boulders."

As there seems to be so little reason in calling a concretion of twenty grains a "stone," and those of nineteen grains "gravel," this factitious distinction may be rejected. It is, on the whole, simpler and more rational to apply the term "calculus" to all concretions which necessitate surgical interference for their removal.

Varieties of Calculi.—Calculi, according to their chemical construction, are classified as follows: 1st. Calculi formed from the natural constituents of the urine, among which are the uric-acid, the phosphatic, and the mixed calculi, and those composed of the urates. 2d. Calculi composed of salts sometimes found in normal urine, but never in excess except in disease. Among these are the oxalates and carbonates. 3d. Concretions formed from elements which are entirely foreign to the normal urine—namely, those composed of indigo, xanthic oxide, and cystine.

In the order of frequency the uric-acid calculi and those composed of urates come first; next, calculi formed of the phosphates and mixed calculi; and, lastly, the oxalates and rarer forms consisting of indigo, xanthic oxide, cystine, etc.

Uric-acid calculi are formed in acid urine; they originate in the pelvis of the kidney, and then descend to the bladder through the ureter, either without causing any subjective symptoms, or, as is frequently the case, their descent through the ureter produces the acute pain known as a "renal colic." When they are once in the bladder they tend to grow constantly larger by accretion from external deposits of uric acid alone, or perhaps they may form merely a nucleus for the growth of concretions drawn from other elements. The pure uric-acid calculus is generally smooth, spheroidal, or slightly flattened, and is of a hardness which, in the absence of a standard, must be called *moderate*.

"High living" and a gouty diathesis are predisposing causes for uric-acid concretions.

The *urates* of *ammonium*, *sodium*, and *potassium* rarely form sizable calculi, although they are often deposited as a sediment in febrile affections or whenever the urine becomes concentrated. Small concretions of the urates, however, probably more often form nuclei for larger calculi composed of other elements. Calculi composed of the urates are, almost invariably, restricted to childhood.

The *phosphatic calculi* come next in point of frequency, and are of three varieties:

(*a*) The *amorphous phosphate of calcium*, which rarely forms a calculus of itself alone, but more often occurs in layers about calculi formed of other salts or is mixed evenly with them. Calculi of phosphate of calcium are chalky-white or of a dirty-brown color, crumble easily, and occasionally are found of considerable size.

(*b*) The *triple phosphate*, or *ammonio-magnesian phosphate*, enters more often into the formation of a calculus than the phosphate of calcium. Such calculi are of a decidedly crystalline formation and of a grayish-white color. They are obviously formed only in ammoniacal urine, and

therefore are purely vesical in their origin, frequently occurring as complications of cystitis.

(*c*) The *mixed fusible calculi*, composed of the triple phosphate and the phosphate of calcium, are rarely uniform throughout, but usually are formed about a nucleus of uric acid, oxalate of lime, foreign bodies, etc. They are soft and pasty in consistence, white in color, and are easily broken up. They likewise are formed in alkaline ammoniacal urine as a sequel to a cystitis set up mayhap primarily by the irritation from a uric-acid calculus or foreign body.

The *oxalate-of-calcium* calculi, like those composed of uric acid, are of renal origin. They occur in patients suffering from oxaluria, a diathesis which usually is found in young persons of indolent, luxurious habits, or which may follow sexual excesses by persons of rheumatic or gouty tendency. Calculi of this variety are of a consistency the hardest of all of the forms of calculus, and, although they may be of most irregular conformation, are usually spheroidal, with a tuberculated surface giving rise to the name of the "mulberry calculus." In color they are dark brown or black. They do not often attain a large size, rarely being over three-quarters of an inch in diameter. Between the tuberculations there are often found thick deposits of the amorphous urates and phosphates. Sections of this calculus show undulating laminæ and a central core made up of concentric layers.

Carbonate-of-calcium calculi are exceedingly rare. They have been always found to be multiple, rarely weighing over thirty to forty grains, very hard and lamellar in structure, similar to the oxalate-of-calcium calculus and also to prostatic calculi.

Cystine, or *cystic oxide*, is a constituent of great rarity. It was first described by Wollaston in 1805. It was then supposed to originate in the bladder, but, like the uric-acid and oxalic-acid calculi, it begins in the kidney. Its surface is irregular and knotty, and in section there is no evidence of systematic crystallization. It is of waxy appearance, yellowish-white at first, but turning to green after long exposure to the air. One of the largest that has been found weighs 850 grains, and is now in the University College Museum, London. Buckston Browne has removed a cystine calculus weighing $2\frac{1}{4}$ ounces.[1]

Xanthine, or *xanthic oxide*, is another of the more uncommon constituents of calculi. It occurs in normal urine only in a very slight degree. Little is known about the pathological significance of these rarer concretions.

Concretions of *indigo* occur as coloring constituents of calculi when cirrhosis of the liver is associated with the vesical disease, and are readily recognized by their color.

Calculi may be thus roughly grouped according to the preponderance of one element, but in point of fact in almost every calculus two or more salts are mixed, either evenly throughout the mass or in layers; an oxalic- or a uric-acid nucleus may have several layers of phosphatic deposits, such as the pure phosphate of calcium or ammonio-magnesian phosphate. If the salts are dissolved out of a urinary concretion, no matter how minute it may be, there will be found remaining an albuminoid or colloid framework on which the salts have crystallized, and which appar-

[1] *Lancet*, Feb. 22, 1890.

ently has served to keep the mass together. The studies of Rainey and of Ord, with regard to the influence which the presence of colloids in the mother-liquor exerts upon crystallization, have demonstrated the fact that when albuminoid or colloid substances are present in solutions of crystalline salts, these salts in crystallization will assume a rounded or spheroidal form. Thus it is evident that the formation of calculi is not wholly due to the mere presence of an excess of any of the urinary salts; copious deposits of the phosphates or of uric acid frequently exist without the formation of a calculus, even though they persist for many months. When, however, during the presence of this over-elimination of urinary salts any irritation is started in the bladder, whereby either blood or serum is mingled with the urine and furnishes an albuminoid substance which favors an agglutination of the small crystals, then calculi readily form, and, once formed, tend to increase in size.

While the shape of vesical calculi is almost always spheroidal when they are free, it varies somewhat according to the position which the calculi maintain; that is, whether they have been contained in a sacculation of the bladder or in the pelvis of the kidney, or have constantly rested in the prostatic portion of the bladder. Again, they are often found irregular in shape, owing to their having split spontaneously or having been ground by friction with other calculi. Ord is of the opinion that the spontaneous splitting of calculi is due to changes in the specific gravity of the urine whereby the colloid framework becomes swollen by absorption of a liquid of different density, and consequently the concretion is fractured along the lines of deposition upon this framework.

The etiology of calculus-formation rests upon two main factors: first, a diathetic tendency to over-elimination of the urinary salts; and, secondly, local conditions which cause these salts to conglomerate.

The diathetic tendency seems to exist in a larger percentage among persons living in certain localities; but these localities where vesical calculus is common are so widespread, and at the same time so totally different in climate, in natural surroundings, and in mode of living of the people, that it is impossible as far as locality is concerned to establish any law which governs calculus-formation. It has been supposed by Harley and others that a limestone soil which furnishes hard drinking-water predisposes to calculus-formation, but, although the disease is common in many limestone districts, it is quite as common elsewhere in freestone districts; it seems improbable that the ingestion of lime should cause uric-acid deposits. Vesical calculi are found in warm as well as in cold countries; for instance, in Southern China and in Northern Scotland. Calculi are more frequently found in the Central United States than in New England and in the Southern States, and it may happen that one portion of a State may furnish more cases than another.

Urinary calculi may exist at any period of life from infancy to extreme old age, but they are more often found in youth. In the statistics of Civiale, Coulson, and Thompson, compiled from an aggregated total of 10,467 cases, 62.33 per cent. were under twenty years of age; these cases, almost all derived, however, from hospital practice among the poorer classes, convey the impression that this percentage may be equally large in all classes; but Sir Henry Thompson has found that when statistics are compiled from private practice this percentage is not so large.

In a series of private cases, 798 in number, he operated for vesical calculus 93 times in patients between the ages of sixteen and fifty; 527 times in patients ranging between fifty and seventy years; 175 times in patients over seventy; and only 3 times in patients under sixteen. The cause of this marked discrepancy between the two tables he attributes to neglect and to the indifference to symptoms in the average adult of the poorer class, and also to bad hygienic surroundings and to malnutrition and irregular diet of children in the lower walks of life. In the middle and upper classes great activity of life generally diminishes between the ages of fifty to seventy, and then, owing to the somewhat sedentary life and to the irregularity in diet and exercise which follow, readily develop a tendency to uric-acid diathesis and to subsequent vesical calculus; among their well-nurtured and cared-for children the disease is almost unknown. From these observations Sir Henry Thompson deduces the conclusion that among children malnutrition, insufficient clothing, and poor hygiene predispose to calculus, but under the same conditions adults escape. Indolence and luxurious and intemperate habits, both in eating and drinking, favor calculus-formation in adult males. That the male sex is so much more predisposed to calculus than the female is probably solely due to the difference in the length and dilatability of the urethra. A small uric- or oxalic-acid concretion entering the bladder from the kidney is not likely to remain in the female bladder, where it can set up an irritation and grow rapidly in size; it will be probably at once washed out through the short urethra. Cases of vesical calculus in women, although rare, do nevertheless occur, and then, in the majority of cases, are found to arise from the intrusion of some foreign body.

Symptoms.—The earliest symptoms of which a patient suffering from vesical calculus complains usually date from a period before the calculus has really entered the bladder; these premonitory symptoms are a brick-dust deposit in the urine and an occasional attack of renal colic due to the passage of the renal calculus down the ureter. These symptoms are by no means invariably present. A renal concretion may pass into the bladder without causing the slightest pain. When the calculus is lodged in the bladder, it becomes a foreign body and gives rise to symptoms of vesical irritation, such as abnormalities of micturition, pain, hæmaturia, pyuria, priapism, etc.

Abnormalities of Micturition.—Undue frequency of micturition is one of the most constant symptoms. It is aggravated by motion, owing to the movements thus imparted to the calculus, and hence is less marked at night. It is also more marked in cases of small and irregular calculi, which by their freer motion and sharp surfaces are apt to set up a greater degree of irritation in the neighborhood of the prostatic urethra than larger, smooth masses, which from their weight are more apt to remain in one position. For a similar reason encysted calculi, or those which are maintained in one position by bands of lymph, may cause hardly any urinary symptoms. The largest calculus I have ever removed (nine and a half ounces)—and I believe the largest one ever removed in this country without fragmentation and with recovery of the patient—had presumably existed for about twenty-six years, and gave the patient very little inconvenience at any time. It was smooth, rounded, and en-

ysted. In elderly men a considerable enlargement of the prostate is very common, and this likewise gives rise to frequent urination, but in these cases the patient is also troubled at night and his symptoms are not so much aggravated by motion. Nevertheless, calculus is a frequent sequel of enlarged prostate, and a careful examination for it is always advisable in a case of prostatic enlargement even when other leading symptoms are not present.

There is another disorder of micturition which is frequently given as a symptom of calculus, and that is a sudden stoppage of the stream, accompanied by pain felt along the urethra, especially near the external meatus. This may occur in young patients, but is rare in adults. According to Sir Henry Thompson, it is wholly valueless as a sign.

The *pain* felt in vesical calculus is not usually referred to the region the bladder, but more often to the under surface of the urethra about inch from the glans. It is burning and stinging in character, and re severe in children than in old men, owing to the development of prostate in the latter, which keeps the calculus away from the vesal neck.

Pain is felt chiefly at the close of urination and continues after the act, the inflamed vesical mucous membrane being brought into contact with the hard and, it may be, rough calculus. This pain sometimes ts until enough urine has again collected in the bladder to distend the walls and free them from contact with the irritating body. The degree of pain of course varies with the size and shape of the calculus; small calculi often cause more pain than those which are larger. The distress caused by a rough or spiculated calculus frequently disappears almost entirely as the case advances. This is due to the rounding off of the surface from the deposition of phosphatic salts or agglomerations of blood and mucus. Occasionally it is due to the fixation of the calculus either by bands of lymph or by its sinking into a diverticulum.

Pain in distant parts of the body is not rarely associated with vesical calculus. At times it is referred to the upper extremities, to the lungs, to the loins, perineum, and rectum. Podalgia—a pain usually situated in one of the toes or along the plantar surface of the foot—is occasionally noted, but disappears as soon as the calculus is removed.

The *presence of blood* in the urine is of value only when associated with other symptoms. It is due to the laceration of the mucous membrane from friction by the calculus, and is consequently most marked after motion and at the close of urination.

In applying the "three-glass test" blood would occur in greatest quantity in the last glass; it probably would not be more marked in the last two or three drops unless prostatitis were associated.

Priapism is a symptom chiefly confined to children, and results from irritation of the prostatico-vesical region; it is exceedingly rare in old men.

Prolapse of the rectum, hemorrhoids, and subconjunctival ecchymoses are symptoms which may be found in children suffering from calculus, and sometimes are available as aids in making a preliminary diagnosis. These symptoms arise from prolonged and violent straining in micturition.

All the foregoing symptoms may be present, but there yet re-

mains the most important sign to be noted before a positive diagnosis can be made—namely, the actual detection of the calculus either by means of the steel sound or by the cystoscope, or by both. With the development of the cystoscope by Nitze a new field has been opened in vesical surgery, and the existence of growths and calculi formerly detected solely by the sense of touch afforded by a steel sound may now be verified, if necessary, by actual sight through the cystoscope.

The method of conducting a cystoscopic examination has been described above; it now remains to deal briefly with the recognition of vesical calculi by means of the sound, which is the most generally available, and the simplest, instrument.

The best vesical sounds are made of solid steel, nickel-plated, and are about twelve inches long. The short arm should be much shorter than in the ordinary catheter, in order that the instrument may be freely rotated within the bladder. Two instruments of different curves are all that are necessary—one with a very gradual curve, and the other with more of an angle, whereby the region of the bladder behind the prostate may be easily reached. The instrument passes through the urethra with greater facility if the point is made slightly larger than the shaft, which should be about 13 calibre, French scale, for adults, and 9 or 10 for children. Sounding for stone is conducted with the patient in a recumbent position, with the thighs slightly drawn up and the shoulders raised in order that the abdominal muscles may be thoroughly relaxed. If the bladder does not contain any urine, a few ounces of warm distilled water or boric-acid solution should be gently injected. Anæsthetization is unnecessary except in young children, whose struggles from fright would render the operation dangerous. The sound, after being warmed and oiled, is introduced in the same manner as a metallic catheter or steel bougie, except that the operator should stand on the patient's right in order that the manipulation of the instrument may be conducted with the right hand. It is also to be remembered that the wide curve of the sound does not exactly correspond to the normal curve of the urethra; therefore it will greatly facilitate its entrance into the bladder if, just as the curve is in the perineal portion of the urethra, a slight downward pressure is exerted upon the penis close to the pubes.

It often happens that the sound touches the calculus just as it enters the bladder; if it does not, it is wisest to pursue a routine method of exploration. First, after having introduced the sound as far as the posterior wall, withdraw it until the curve is at the internal orifice of the urethra; then again push it inward, at the same time rotating it on its long axis in a series of gentle tapping motions, first to the right of the median line, then to the left. Then by turning the point downward in a similar manner explore the lower half of the bladder. If the calculus be not detected by any of these movements, the sharply-curved instrument should be introduced and the region back of the prostate explored; calculi may also lodge on the anterior vesical wall above the urethral orifice; such positions may be explored with the second instrument. To the experienced ear the metallic click produced by the contact of the sound with the calculus conveys abundant information.

The sharp sound produced by simple oxalate-of-lime calculi may often be distinguished at once from the somewhat muffled click produced by the more friable and soft uric-acid and phosphatic calculi. In like manner, the click produced by an encysted or adherent concretion is not the sharp, quick sound which is produced by a free calculus, which touches the instrument and bounds away from it. Similarly, the size of the calculus may be pretty accurately estimated by the note which it produces when touched. Many surgeons rely as much upon the sense of touch as upon the sense of hearing, but the late Dr. Agnew of Philadelphia, whose reputation as a diagnostician was world-wide, and whose experience in cases of calculus rendered his opinion of great value, expressed himself as firmly convinced that if the whole history were known of all the cases in which patients had been needlessly operated upon for calculus, it would be found that many errors in diagnosis had arisen from the reliance by the surgeon on his sense of touch instead of on his sense of hearing. The sound produced by the contact of the calculus with the instrument may be greatly magnified by screwing to the handle of the latter the sounding-board of L'Estrange, which simply consists of a circular piece of thin wood attached by a central screw.

A calculus, however, may escape detection even after a most carefully conducted search, the sources of error being either that the stone is so light that it will not produce a click nor even cause a jar to the searching instrument, or it may be so coated with mucus and blood that it produces no different sensation than that produced by contact with the the bladder-walls. It is also possible that the sound may enter a sacculation in the urethra or just at the neck of the bladder, and thus fail to explore, or even to reach, the bladder at all, or perchance the calculus may be confined entirely within a pouch in the mucous membrane and thus elude the sound. Sometimes it is possible to overcome this last difficulty by introducing a finger into the rectum and lifting the stone out of its place of lodgement. Harrison[1] advocates the use of Peterson's rectal colpeurynter when such a condition is suspected. This instrument consists of a soft-rubber bag with a tube attached, and is introduced into the rectum in a collapsed condition, and then distended with air or water so that it lifts the bladder up. By means of this rectal bag injected with two or three ounces of water the depressed posterior wall of the bladder is brought up almost to a level with the prostate, and thus any sacculations existing in this portion are turned inside out and the enclosed calculus extruded into the bladder proper.

A tolerably accurate knowledge of the size of a calculus may be obtained by means of a simple instrument devised by Thompson consisting of a sliding metal ring which surrounds the shaft of the sound. The point of the sound after it touches the calculus is pushed along, constantly tapping it, until it reaches the farther edge, and when it slips down behind the calculus the ring is slipped forward upon the shaft up to the meatus; then the sound is again gently withdrawn, tapping the upper surface of the concretion until it reaches its anterior edge; then the width of the stone corresponds with the distance between the meatus and the movable ring.

Although in many instances, in children more than in adults, the

[1] *Lancet*, March 14, 1891.

presence of a calculus in the bladder excites no symptoms whatever, it is the general rule that more or less severe pathological changes are provoked. Cystitis, which may have existed earlier than the calculus, or if not is pretty sure to be set up, is constantly aggravated by the irritation, and the mucous membrane becoming thickened and rigid and the submucous coats involved, deep ulcerations may form which in some few cases perforate the walls. The prostate gland seldom escapes in such a process; hypertrophy, with consequent obstruction of the outflow of the urine, ensues, and thus in turn the septic urine is driven back to the kidneys, where suppuration may convert the whole organ into a sac containing many calculi. Such cases are, fortunately, rare at the present day, and the comparatively slight danger attached to the operations for the relief of vesical calculus seldom allows the disease to assume great gravity.

Treatment.—The treatment of vesical calculus may be broadly divided into two methods—*Solvent* and *Operative*. The former consists in dissolving the calculus by means of appropriate drugs, and the latter may be subdivided into removal by an operation *ab extra* (*lithotomy*), and pulverization *in situ* by appropriate instruments (*lithotrity*).

The *solvent treatment* has been known from the earliest times, but only in the rarest cases, when there is absolutely no trace of cystitis and when the calculus is composed of soft phosphates, can the thought of this treatment be entertained. Acids or alkalies of sufficient strength to dissolve a calculus are quite strong enough, when injected into the bladder, to act upon the hypersensitive mucous membrane. When administered by the mouth they are of assistance as prophylactics, but are never eliminated in the urine in sufficient strength to have any action upon the calculus itself. In cases, however, when no operative procedure is deemed advisable the use of alkalies internally administered is justifiable. Roberts has shown that by the administration of thirty to forty grains of potassium citrate every three or four hours during some days a decided alkalization of the urine follows, corresponding, in fact, to about fifty grains of potassium carbonate to the pint of urine (potassium citrate, it will be remembered, is eliminated as the carbonate); and a solution of this strength is capable of dissolving a uric-acid calculus at the rate of about twelve and a half grains in twenty-four hours, provided there is no albuminous or phosphatic coating to keep the solution from direct contact with the calculus. Piperazine is another drug which in the last few years has attracted considerable attention as a solvent for uric acid, and also, it is claimed, for the albuminous or colloid material upon which calculi are formed. It is given in the daily dose of fifteen grains, and is also recommended as an injection of 2 per cent. strength for the solution of calculi *in situ*. Biensenthal[1] has experimented with this drug in animals; he produced artificial deposits of urates in the heart, pericardium, bladder, and kidneys in 112 animals, 29 of which were treated with piperazine, 36 with various other substances to serve as control subjects. The aforesaid drug was given either in the form of pills or of subcutaneous injections in the maximum daily dose of 0.75 grammes. The animals were killed after two to seven days' treatment, when no trace of the deposits

[1] *Union Méd.*, Nov. 16, 1893.

could be found in the organs of the piperazine subjects, whereas the urate deposits in those animals treated with boric acid, lithia, and sodium phosphate were unaltered.

Operative Treatment.—Down to the beginning of the present century cutting for stone was the only method practised; the perineal method is the oldest of these operations, and dates from prior to the commencement of the Christian era. Celsus furnishes us with the earliest account of this operation, which was performed by drawing the stone down to the neck of the bladder by means of the thumb and fore finger introduced into the rectum, and, held in this position, it was cut down upon through the perineum. The bladder was entered either through the neck or through the walls as the case might be. The greater safety of entering the bladder through its neck was, however, soon recognized. Paulus Ægineta,[1] in speaking of the operation, gives the line of incision toward the left buttock, so that the bladder is opened at its neck and not through its substance, and Lanfrank, writing about 1400 A. D., cautions strongly against cutting the substance of the bladder, for "that were mortal."[2]

The suprapubic operation was not employed until 1560, by Pierre Franco, who performed it as a last resort in a case where the stone was too large to be extracted through a perineal wound. From his time this operation was little used until 1719, when it was again adopted by Douglas, and in 1723 by Cheselden. It has always had fluctuations of popularity, and even now in this age of anæsthetics and of antiseptic surgery it is still performed in cases of extremely large and hard calculi or where, owing to prostatic hypertrophy and chronic cystitis, other methods are impracticable. In 1824, Civiale made the first attempt involving practical results to remove calculi without using the knife—an operation which has since then developed into what is now called lithotrity. His instrument had three straight blades, between which he could grasp the calculus and drill it full of holes; it could be then readily crushed into small particles, which were subsequently passed through the urethra with the urine. Directed by this hint, attention was speedily turned to modifications and improvements of Civiale's method. The plan of drilling was soon abandoned, and sundry two-bladed curved lithotrites came into use, wherein thumb-screws were used to apply the needed crushing power. By Ferguson's ingenuity this requisite crushing power was obtained by a rack and pinion in a speedier manner than by these thumb-screws. Civiale next improved upon himself, and devised an instrument whereof the distinguishing trait is that the two curved blades or arms can be approximated, for grasping the calculus, by simply sliding; for crushing the calculus, after it has been firmly grasped by them and the blades locked, the power is applied more steadily and forcibly by means of a thumb-screw.

Thus, after many trials and modifications, the modern almost perfect instruments have been finally evolved—such instruments, for instance, as Thompson's and Bigelow's.

The primitive operation of crushing the calculus (lithotrity) was

[1] *Syd. Soc.*, 1846, p. 355.

[2] Lanfrank's *Science of Cirurgie*, Early English Text Soc., 102.

divided into several stages: the operator was usually content, at one sitting, with giving the calculus merely two or three fractures, and then, several days later, he repeated the operation, until finally all the fragments had been passed in the urine through the urethra.

In 1878 lithotrity, with its gradual evacuation of the débris, was entirely supplanted by the use of the instruments devised by Bigelow, whereby, at one operation, the calculus is completely comminuted and the débris removed. The almost universal applicability of this operation for the removal of vesical calculi, together with the exceedingly slight risk which it involves, has made it supersede the cutting operations, which at the present day are the exception and not the rule. This operation Bigelow has called "litholapaxy."

Preliminary Preparation.—There are certain preliminary preparations to be made whether the patient is to submit to lithotomy or to litholapaxy. Rest in bed for at least two or three days before the operation is necessary in order to give a rest to the bladder and allay the irritation from movements of calculi. The condition of the urine should be carefully ascertained with regard to the presence of pus, blood, albumin, ammoniacal fermentation, etc.; on these conditions the choice of operation and subsequent treatment must largely depend.

Should there be a cystitis manifesting itself by ammoniacal fetid urine, it should be treated by mild irrigations of the bladder with a solution of boric acid, nitrate of silver, or of potassium permanganate, and internal administration of boric acid or salol in five-grain doses. Just before the operation the perineum and pubes should be shaved to obtain complete asepsis, no matter what the operation; this is equally essential in litholapaxy, where, although no incision whatever is made, the instruments and hands come constantly in contact with the parts just mentioned, and the danger of vesical infection is great unless thorough asepsis throughout is maintained. The bowels should be emptied by an enema about four hours before the operation.

As has been said, operative treatment may be, in general, divided into lithotomy and lithotrity. Lithotomy may be subdivided into *perineal* and *suprapubic*. Perineal lithotomy may be again subdivided into *lateral*, *median*, *bilateral*, and *medio-bilateral*.

Perineal Lithotomy.—Incision of the neck of the bladder through a perineal wound for the extraction of calculi is still performed in many cases where the simpler operation of litholapaxy is impracticable. According to some surgeons of the present day, it is always the operation to be selected for young children, but this position seems no longer tenable. (See p. 593.)

In relation to all forms of incision through the perineum the following anatomical points have a bearing: The perineal space is lozenge-shaped, its points being the symphysis pubis, the tuberosities of the ischia, and the tip of the coccyx. A line drawn between the ischial tuberosities passes directly through the anus, which is about one and a half inches anterior to the tip of the coccyx. The true perineum, which is the space involved in the operations for lithotomy, is the triangular portion bounded laterally by the rami of the pubes and the ischia, having its apex at the pubic arch and its base the imaginary line drawn between the tuberosities of the ischia. The "perineal centre" is a point

midway between the perineo-scrotal junction and the centre of the anus; it is the surgical landmark to the middle of the lower edge of the triangular ligament, and a little in front of this point lies the bulb of the penis with its arteries. The perineum is divided into two parts by the median raphe, which starts at the anterior edge of the anus and extends up over the scrotum, marking the medium line beneath which, similarly to the linea alba of the abdomen, there are no arteries of any size. The depth of tissue lying between the skin and the bladder in the average adult male is about two and a half to three inches when measured near the base line of the true perineum and about an inch in the anterior portions.

For the *performance of the lateral operation* the following instruments are required: A lithotomy knife, which is merely a scalpel with a blade at least three inches long and with a moderately heavy handle; a probe-pointed bistoury for enlarging, if necessary, the incision in the prostate; a grooved lithotomy staff with a large curve: the groove may be either on the under surface or on the side; the lateral groove is perhaps to be preferred, however, owing to the greater facility with which it can be felt and located by the finger in the wound: in any event, the groove must be so deep that the point of the knife shall not slip out of it; lithotomy forceps, both curved and straight: the straight forceps is usually sufficient, but the calculus may be lodged in a post-prostatic pouch, in which case it can be reached only with a curved forceps; a scoop for removing débris or dislodging calculi from pouches in the mucous membrane; a large-sized soft-rubber catheter, also for washing out débris; and a catheter *en chemise*, or a Buckston-Browne's air-tampon, which is to be used in case the venous hemorrhage is excessive.

The catheter *en chemise* is an ordinary rubber catheter passed through the centre of a six-inch square of muslin, the muslin tied around it about three inches from its end, more like a petticoat, by the way, than a chemise; the catheter, thus prepared, is then passed into the bladder through the wound, and the space between the catheter and the inner surface of the muslin is packed with iodoform gauze. Buckston-Browne's air-tampon is a catheter surrounded about three inches below its eye by a distendible rubber bag, which, when inflated with air, holds the catheter in place in the bladder and exerts pressure upon the bleeding surfaces.

It is advisable also to have a lithotrite at hand in case the calculus proves too large to be extracted whole, and of course all other minor instruments which are necessary in all operations—namely, hæmostatic forceps, a tenaculum, sponges, etc.

The patient, having been thoroughly anæsthetized, is placed upon the operating table, and before being brought into the lithotomy position is again sounded for the calculus to make sure of its presence. He is then brought down to the edge of the table and the thighs flexed at a little more than a right angle to the abdomen, and the legs flexed on the thighs, and so held in position either by two assistants or by means of a crutch, which is strapped between the knees and holds them apart while a strap passes from it over the shoulders and maintains the flexion of the legs. The grooved staff is then introduced into the urethra (it is a wise and prudent safeguard to make it touch the calculus if possible) and held in position by an assistant, who should be instructed to keep

pulled up against the symphysis and a little inclined toward the groin.

ıe surgeon then makes the incision through the superficial fascia, ning at a point about an inch and a quarter in front of the anus little to the left of the median raphe, and extending about three s downward and outward in the ischio-anal portion of the peri-, inclining slightly more toward the ischium in order to avoid the f wounding the rectum. This first incision is deeper in the ante-portion, and traverses the skin, superficial fascia, transverse peri- muscle, possibly a few posterior fibres of the accelerator urinæ le, branches of the superficial perineal artery and nerve, and the rior edge of the superficial layer of the triangular ligament, and, e lower part of the incision, the inferior hemorrhoidal vessels and . The space which contains the membranous urethra between the ficial and deep layers of the triangular ligament has now been d, and the surgeon passes his finger into the wound and feels for taff, and then, with his left fore finger as a guide, he passes the of the knife into the groove, and either by holding the knife in the groove, and then pushing the staff and knife together rd, or by simply sliding the point along the groove, the knife s the bladder at its neck.

pushing the knife forward the handle should be depressed, so that icient cut shall be made with the heel of the blade through the left f the prostate for the convenient extraction of the calculus. The of the knife should also be kept parallel with the external wound. this cut the deep layer of the triangular ligament, the anterior of the levator ani, and a portion of the compressor urethræ are ed, and an opening made in the membranous and prostatic urethra; eft lobe of the prostate is also divided. As soon as the knife s the bladder a gush of urine, or of the fluid injected to distend ladder, flows from the wound. The wound in the prostate may be y enlarged as the knife is withdrawn, but it is safest to make the d as free as possible by depressing the handle of the knife while p is being pushed forward in the groove of the staff; there is some er of cutting into the rectum if the cut is enlarged while withdraw- he scalpel. The surgeon now introduces into the bladder his left inger, guided by the groove of the staff, and when his finger touches alculus the staff is then, and not until then, withdrawn.

ı children, in whom the prostate is a rudimentary body and the of the bladder is often too small to admit the finger of the operator, se of a blunt gorget, a broad straight-bladed knife with a blunt point which follows the groove of the staff, may be of advantage; the flat surface of the gorget after it has entered the bladder the ps may be guided, inclined slightly more toward the symphysis in the case of adults, because of the higher position of the bladder ry young patients.

Then the operator's finger is within the bladder the closed forceps ided alongside of it until it too is well inside. Then it is opened otated on its long axis to the right, so that the right-hand blade act as a sort of scoop and slide underneath the calculus, which grasped should be extracted by a gentle see-saw motion, with trac-

tion exerted somewhat upward and forward in the axis of the pelvis when in the recumbent position. If the forceps fails to grasp the calculus at the first trial, it should be swept gently across the bladder in search of it; if it still fail to come in contact with the calculus, then it is probably situated behind the prostate, and the curved forceps may be used with the point directed downward and the handle slightly raised; it will be able then to grasp the calculus in the depression behind the prostate. If the edges of the wound in the bladder will not slip over the calculus, they may be gently pushed back over it with the finger, but it is better to nick the edges of the cut slightly with the scalpel than to use force enough to tear them. The cut in the prostate, however, should never extend entirely through the left lobe, as this would intrench upon the neck of the bladder and the recto-vesical fascia, and enhance the danger of urinary infiltration and peritonitis. After the extraction of the calculus it is advisable to explore the bladder again, either with the finger or with a sound, to make sure that there are no other calculi present.

It sometimes happens that the calculus is too soft to withstand the pressure of the forceps, and so breaks into several pieces, or may even crumble; this accident not only prolongs the operation by necessitating the use of a scoop and careful washings to get rid of the particles, but, moreover, it has frequently happened that a small fragment of the calculus remaining behind has formed the nucleus for a new concretion and necessitated a second operation.

Other complications may occur. Among them are—first, an excessive hemorrhage, which may follow the first incision from the wounding either of the distended hemorrhoidal vessels or of the artery of the bulb, which may perhaps occupy an anomalous position. This hemorrhage is in general quite easily arrested by means of a hæmostatic forceps, which may be left on until the operation is finished, when the bleeding will probably be found to have ceased; if not, the vessels should be ligated. A hemorrhage which comes from the deep part of the incision is never quite so profuse, and moreover it usually stops from the pressure by the fingers in the wounds and by the instruments introduced; but if these prove insufficient, it may be controlled by means of the catheter *en chemise*, or by Buckston-Browne's tampon, inserted after the calculus has been extracted. It may happen that, through careless manipulation, the staff may fail to enter the bladder, and be caught in a urethral diverticulum. Serious damage may result from this accident. As soon as this faulty position of the staff is discovered, the staff should be partially withdrawn and reinserted so that it again touches the calculus.

It has also happened in lithotomies performed on children that, owing to the size of the calculus or to the smallness of the incision in the neck of the bladder and in the prostate, an excessive backward pressure has been exerted upon the bladder, and the membranous urethra has been completely torn across, while the bladder has been pushed up into the pelvis; at the same time a cavity is formed in the recto-vesical space. From this accident cellulitis, urinary infiltration, and peritonitis, will scarcely fail to result, followed by death. The only course to pursue in such a case is to perform suprapubic cystotomy, and pass a catheter from within out through the urethra, and stitch the torn ends together.

Wounding of the rectum from an insufficient lateralization of the blade of the knife may occur, but, as a rule, it is not a very serious accident, the wounds healing almost always spontaneously; a fistula may, however, result, and it is best to stitch the wound in the rectum at once if possible. Care should be taken in cases of contracted bladder that the knife be not pushed forward too far into the wound, as there is danger of cutting through the posterior wall, from which accident peritonitis would surely follow. It may happen that the perineum is so deep that it is impossible to get the finger into the bladder to touch the calculus and guide the forceps. This complication is so serious that when it is possible to anticipate such a depth of perineum it is advisable to select some other operation than the perineal incision. When, however, this is discovered too late, and the incision has been made, then the forceps may be guided into the bladder by means of a blunt gorget with thin but not sharp edges, which may be withdrawn as soon as the calculus is in the grasp of the forceps.

The gorget at one time was an indispensable adjunct to all lithotomies, but it is now used only in exceptional cases. It was originally merely a broad probe-pointed knife employed to make the wide incision in the prostate; but if used, its use should be restricted to guiding other instruments (in this case its edges need not be sharp) or to enlarging slightly the wound in the prostate without taking its probe point from the groove of the staff, when, of course, it needs to be sharp.

Enlargement of the prostate may also necessitate the use of the gorget as a guide in place of the finger. In such cases there is also likely to be extreme rigidity of the neck of the bladder, and in order to get any instrument into the bladder the prostatic urethra must be fully dilated. This dilatation is best accomplished by means of Dolbeau's bladed dilator, an instrument on the principle of an umbrella, whereof the blades can be widely separated after the point has been directed into the wound along the groove of the staff. In a case of calculus and enlarged prostate Bolton Bangs[1] has found complete disappearance of the urinary symptoms following this forcible dilatation of the prostatic urethra. In this case, however, a suprapubic cystotomy had been performed some years previously, and a calculus weighing four hundred grains had been removed, together with two small prostatic outgrowths on each side of the urethra.

The After-treatment of Perineal Lithotomy Cases.—When the calculus has been extracted and the bladder has been explored for other chance calcareous deposits adhering to the walls, or for other concretions, the bladder should be thoroughly irrigated with moderately hot water to wash out any clots of blood which may have entered it and also to stop any slight oozing from the edges of the wound. If the hemorrhage be considerable and the vessels cannot be ligated, the air-tampon or catheter *en chemise* should be inserted. The packing which is inserted within the cuff of the latter instrument may be removed at the end of two or three days. Dr. W. A. Mackay reports[2] favorably on the use of glass tubes for drainage after perineal or suprapubic lithotomy when cystitis is associated. To the end of the glass tube, a soft rubber tube is attached, and conveys the urine to a vessel beneath the bed, in which the end of the rubber tube

[1] *Annals of Surgery*, April, 1893.

[2] *Lancet*, Mar. 12, 1892.

is kept constantly submerged in an antiseptic fluid. The glass tubes should be slightly smaller in calibre than those ordinarily used in abdominal sections. No other dressing is used except light packing around the tube and a T bandage in perineal cases. Drainage should be maintained until the urine becomes clear.

When prolonged drainage is not deemed necessary and the hemorrhage is not sufficient to demand packing the wound, then only a light pad of iodoform gauze should be applied, but not pressed in so tightly as to prevent the free escape of urine through the wound, which will continue for a day or so, and then, owing to the inflammatory swelling, gradually cease. The patient should be placed in bed on his back, with some absorbent material under his buttocks to catch the urine; his thighs should also be protected from the irritation caused by the urine by means of vaseline or of boracic ointment and by frequent sponging with alcohol.

Immediate suture of the perineal wound has been tried, but experience shows that it is attended with great risk; the deep portions of the wound, which have been more or less bruised by instruments, may slough slightly or heal more slowly than the skin-surfaces, and in this event extravasation of urine is likely to occur; whereas if the wound be allowed to close slowly, healing begins at the bottom. After perineal lithotomy the patient should remain in bed for from two to four weeks, except in the cases of children, who recover very rapidly after the operation.

Median Lithotomy.—This operation differs from the lateral in that the incision is in the median raphe between the scrotum and anus. The patient is placed in the same position as for the lateral operation, and the staff with a groove on its under surface is introduced and held pressed well up against the arch of the symphysis. The point of the knife, preferably a narrow, straight bistoury, is inserted at the perineal centre, just avoiding the bulb of the urethra, and pushed on until it slips into the groove of the staff in the membranous urethra, in which an opening about three-fourths of an inch is made. Then the surgeon's left fore finger is inserted in the wound and pushed on through the prostatic urethra into the bladder. The staff is then withdrawn and the forceps introduced. If the parts are too resistant to allow the insertion of the finger, the prostatic urethra may be dilated sufficiently by means of Dolbeau's dilator. This strong resistance of the parts is, however, rare, and it is best to attempt dilatation by the finger, which is not so apt to lacerate the vesical neck as are hard instruments. More room may be obtained if a grooved director is passed into the bladder before the withdrawal of the staff, and along this the finger is guided through the prostatic urethra. In this operation the skin, superficial fascia, sphincter ani, the lower edge of the triangular ligament, the compressor urethræ, the membranous urethra, and the apex of the prostate are incised, but no vessels of any size are divided.

It is claimed as advantages for this operation that there is no risk of wounding the seminal vesicles or ejaculatory ducts, and, as no arteries are divided, hemorrhage is very slight; there is great risk, nevertheless, of wounding the bulb of the urethra—an accident whereof the dangers are much exaggerated, however, in the usual descriptions of this operation.

This median operation was formerly known as the "Marian" operation, and dates from the sixteenth century, but is now generally known as "Allarton's operation of lithotomy."

Dolbeau's modification of this operation consists in dilating the prostatic urethra and introducing a lithotrite through the wound, crushing the calculus, and washing out the débris at one sitting. This operation has naturally fallen into disuse at the present day, owing to the improved instruments for litholapaxy.

Bilateral Lithotomy.—In this operation a crescentic incision is made about a half to three-quarters of an inch in front of the anus and extending down on each side to a point midway between it and the tuber ischii. The incision is deepened until the membranous urethra is exposed over the grooved staff; the urethra is opened and the curved *double lithotome caché* is introduced along the staff into the bladder.

This *lithotome caché*, as devised by Dupuytren, is an instrument with somewhat the curve of a sound and with two sharp blades, which can be diverged from the staff so that when introduced into the bladder through the urethra these blades may be expanded, and then by withdrawing the whole instrument a wide cut is made through both lateral lobes of the prostate. As soon as the lithotome touches the calculus in the bladder it is turned with its curve downward and the staff withdrawn; then the blades are opened to the desired width and the instrument withdrawn, dividing the lobes of the prostate from within outward. The handle of the instrument should be slightly depressed, and maintained exactly in the median line as it is withdrawn. The surgeon's finger is then introduced into the bladder and the forceps guided in, and the calculus extracted as it is by the lateral incision. The advantages claimed for this operation are the avoidance of the larger blood-vessels and the free admission that is gained to the bladder. In practice, however, it is no more successful than the lateral operation, which in the hands of a skilful operator is at least less complicated. The statistics of this operation, collected by Gross from a series of 536 cases, show a mortality of about 7.64 per cent.

Medio-bilateral lithotomy, or Civiale's operation, is a modification of the preceding, whereby the first incision is made in the median line and deepened until the membranous urethra is opened without wounding the bulb. A *straight* lithotome is then introduced, and on withdrawal divides both lobes of the prostate as in the bilateral method.

These operations have at the present day fallen into disuse.

Suprapubic Lithotomy.—Extraction of the calculus through an opening above the pubis was, it is alleged, first performed by Pierre Franco in 1561. He did not recommend the operation, having performed it himself only at the last extremity, and deemed it too dangerous to be repeated. The operation, however, was subsequently performed in England by Proby, Douglas, Cheselden, and Prye, but did not gain much popularity, owing to the great danger of urinary infiltration and peritonitis. It was first performed in this country (according to Agnew)[1] by Prof. Gibson of the University of Pennsylvania, and resulted in death from peritonitis. Since the introduction of Petersen's method of increasing the space between the pubis and the peritoneal attachment

[1] *Agnew's Surgery*, p. 691.

on the anterior wall of the bladder by means of distending the rectum and bladder, the suprapubic operation has gained greatly in favor, and is now almost universally employed for the extraction of calculi too large and too hard to be crushed by the lithotrite, and for encysted calculi.

The Operation.—The patient should be prepared in the usual manner as for a lateral lithotomy, due regard being had to rendering the skin of the abdomen aseptic; the pubic hairs should be shaved, and the rectum thoroughly emptied by an enema just before the operation. The surgeon should make sure of the presence of the calculus by sounding before any further steps are undertaken.

The patient, being thoroughly anæsthetized and relaxed, is placed on his back upon the operating table with the pelvis and shoulders slightly raised in order to relax still further the abdominal muscles. The peritoneum, it must be remembered, is attached to the anterior surface of the bladder as far down as the remains of the urachus, and posteriorly it descends between the bladder and rectum; when these are empty the portion of the bladder which has no peritoneal covering lies behind the pubic bone and is inaccessible. When the bladder is distended it rises above the pubis, and the peritoneum, which is loosely attached anteriorly, rolls back, and a considerably greater interval of the bladder-wall uncovered by peritoneum is exposed. If the rectum alone is distended, it simply raises the posterior part of the bladder, and hardly increases the suprapubic interval at all. If, however, the rectum and then the bladder are distended, the bladder is lifted up against the anterior wall of the pelvis, and, since it cannot press downward into the perineum, it stretches up into the abdominal cavity. This device for increasing the peritoneo-pubic interval by distention of both bladder and rectum is known as the "Garson-Petersen method," and by it this space is increased to its utmost extent. The rectum is distended by means of a dilatable rubber bag known as "Petersen's rectal colpeurynter," which is oiled, and, while collapsed, is slipped into the rectum well above the sphincters. The bladder should then be emptied and washed out with a warm boracic-acid solution; eight or ten ounces of fluid are then forced into the rectal bag. Greater distention than this is dangerous in the adult; in children of course the amount must be governed by the size and age of the patient, otherwise there is great danger of laceration of the mucous membrane of the rectum. When the rectum has been distended the bladder should be gently injected in the case of full-grown patients with ten or twelve ounces of boracic-acid solution, and in children with from three ounces up to seven or eight as the case may be. The amount can be best estimated by the resistance imparted to the bulb of the injecting syringe and by the degree to which the bladder rises above the pubis. In children the bladder is to a great extent an abdominal rather than a pelvic organ, so that in many cases distention of the rectum is unnecessary; injection of the bladder and the Trendelenburg position will frequently accomplish all the displacement that is desired. In fact, some surgeons, regarding the rectal bag as dangerous, maintain that even in adults a sufficient amount of displacement is obtained by vesical injection and by elevation of the pelvis. The bladder and rectum having been distended, an incision is made, beginning over the

pubis in the median line and extending up the abdomen for two and a half to three inches, or even more, according to the size of the calculus and the degree of distention of the bladder. This cut is carried down directly in the linea alba between the recti and pyramidales muscles, and, the aponeurosis of the external oblique being divided on a grooved director, the loose cellular fatty tissue in front of the bladder is exposed. This loose cellular tissue should be separated in the median line and pushed aside with the handle of the scalpel; probably it is almost impossible to avoid tearing it free somewhat from the upper surface of the bladder, but extreme care should be taken to guard against this as much as possible, as it favors urinary infiltration.

Senn [1] advises two stages in the operation in cases of septic cystitis: After the anterior wall of the bladder has been exposed and all hemorrhage arrested, the wound is packed with iodoform gauze and the dressing held in place by strips of adhesive plaster; this dressing is allowed to remain for five days; at the end of this time the wound, if it has remained aseptic, is covered with a layer of healthy granulations, which have closed the connective-tissue channels and have shut out from the wound the remainder of the prevesical space. As a second stage, with the danger of infiltration lessened by these favorable circumstances, the bladder is incised and drained in the usual manner; under this operation cocaine is adequate without general anæsthesia. In relation to this modification of suprapubic cystotomy Senn makes the following statements: "1. Necrosis and phlegmonous inflammation of the margins of the wound and the tissues in the prevesical space (cavum Retzii) not infrequently occur as complications of suprapubic cystotomy if the operation is performed for affections complicated by septic cystitis. 2. Suprapubic cystotomy in two stages greatly diminishes, if it does not entirely overcome, this source of danger. 3. In the first operation the bladder is freely exposed in the usual manner, when the prevesical fat is dissected away over a vertical oval space at a point corresponding to the location of the proposed visceral incision, after which the wound is packed with iodoform gauze and the external dressing is applied in such a manner that it cannot be displaced. 4. The incision in the bladder and the intravesical operation are postponed until the external wound has become covered with a layer of active granulations, which usually requires from four to six days. 5. The second operation can be performed with the aid of cocaine without general anæsthesia. 6. This modification of suprapubic cystotomy diminishes the immediate risks of the operation and affords protection against a number of serious *post-operation* complications."

When, however, the operation is to be performed at one sitting, that portion of the bladder which is uncovered by peritoneum is exposed; it should be transfixed by a tenaculum in the upper portion of the abdominal wound, and then an opening made in it sufficiently large to admit the fore finger of the left hand, which must be inserted to hold the bladder in place. The opening in the viscus may now be enlarged, if necessary, with a probe-pointed bistoury, and the forceps or else the index finger of the right hand is introduced, so as to oppose or aid the other fore finger; the calculus is then grasped and withdrawn. Careful

[1] *Med. News*, July 1, 1893.

search should be also made for any fragments of calculous material which may remain behind. The condition of the prostate should be also ascertained; it often happens that small prostatic growths, obstructing the internal urethral orifice, are the predisposing cause of calculus-formation; their removal lessens the chance of recurrence of the calculus and frequently relieves troublesome urinary symptoms. If the bladder be in a fairly healthy condition, general experience of late years has been that it is safe to suture the wound in the bladder completely at once. In such cases Anderson[1] proposes to test the tightness of the wound by injecting the bladder with air or water and by closing any leaks which may be detected.

If it can be determined before the operation that the case is one for immediate suture of the vesical wound, the incision in the bladder-wall should not be carried too close to the pubis, for as soon as the bladder has collapsed this part of the wound becomes entirely inaccessible. In suturing the wound Lembert-stitches should be used, not penetrating the mucous membrane, and sufficient in number to ensure water-tightness, which may be tested by Anderson's method. It is an extra precaution to fill the wound with water, and then distend the bladder with air to make sure that it is also air-tight. If there be apprehension of leakage, a small drainage-tube may be left in the prevesical space for forty-eight hours. The urine should be drawn off with a soft catheter about four hours after the operation; permanent retention of a catheter in the urethra for drainage is injurious. The patient usually passes his water voluntarily through the urethra, but it is best not to wait for the bladder to become distended, but to draw off the urine every four hours or so, for a day or two following the operation.

When immediate suture of the bladder is successfully performed, the wound is entirely healed in two to three weeks. When, on the other hand, there is a considerable degree of cystitis and the bladder-walls are thin or much irritated, immediate closure of the wound is inadvisable. In these cases the bladder should be drained through the wound for ten or twelve days, or until the urine becomes healthy and is passed in considerable quantities through the urethra as well as through the wound. Two drainage-tubes should be placed in the lower angle of the wound and stitched to the skin as soon as the rectal bag has been emptied; two tubes are not absolutely necessary, but it is a precaution in case one should become clogged, and it is also more convenient for irrigation.

Hunter McGuire says:[2] "From my observation of drainage in the cases of suprapubic cystotomy in the male I find it more complete than in drainage after sections through the perineum. In theory it may not seem so, but in practice I have found it to be the case. The other advantages of suprapubic cystotomy for drainage are apparent. The operation is simpler and far less dangerous to life than any cut into the bladder through the perineum. You go through parts less richly endowed with nerves, blood-vessels, etc.; if a fistula is left and it is above the pubes, it is not constantly leaking or as difficult to manage as a perineal urinary fistula, and there is no danger of impotence, as I have once seen after the latter operation. In drainage through the perineum the man remains on his back in bed and a tube is kept constantly in the

[1] *Lancet*, April 26, 1890.

[2] *Medical News*, May 17, 1890.

bladder. In the suprapubic method the man can often sit up in a week, or sooner, perhaps, and do without the tube for several hours at a time."

Cobb[1] claims success for a method which he devised whereby drainage is effected by capillary attraction: this he obtained by means of a long strip of iodoform gauze, one end of which passes into the bladder through a glass tube, and the other end, passing through a three-foot long rubber tube, connects with a bottle over the bedside. It is also safer to put in a few deep sutures at the upper angle of the abdominal incision. This precaution has been found necessary in order to avoid the danger of ventral hernia through the cicatrix. The wound should be dusted with iodoform and an absorbent aseptic dressing packed closely around the tubes.

After the drainage-tube has been withdrawn the wound usually closes in about two weeks. It is safe to predict at least one month for recovery from the operation when vesical drainage has been necessary.

Profuse venous hemorrhage, due to pressure on the veins by the rectal bag, may occur as soon as the prevesical space is opened; the bleeding should be controlled as much as possible before the bladder is opened, as blood-clots seriously impede drainage. The violence of the hemorrhage abates instantly and almost completely as soon as the rectal bag is emptied.

Litholapaxy.—To Professor Bigelow of Boston is due the credit for devising a method of operation which, since the first operation for "stone" was performed, has made the greatest advance in the surgery of the genito-urinary tract. He brought it into practice in 1878, and since then it has supplanted all the cutting operations, save in exceptional cases. At first it was deemed inapplicable to small children, but in experienced hands at the present day the results, even with youthful patients, are so successful that lateral and suprapubic lithotomy are relegated to exceptional cases. Bigelow's first plan was to perfect the lithotrite so that comminution of the calculus was more complete; he believed that the poor results and frequent recurrence of calculus after the old operation of lithotrity were due to the irritating fragments left in the bladder. The lithotrite which he devised—and which is still the best—consists of a male and female blade that slide upon each other, and, when the calculus is grasped, may be locked and then still further approximated by a powerful screw. The principle of alternate sliding and screwing did not originate with Bigelow—Civiale, as has been noted above, adopted this principle—but it was the modification of the jaws of the instrument to which Bigelow paid especial attention. The great difficulty with the old lithotrites was that the jaws were constantly in danger of becoming clogged with fragments of the calculus, and thereby lacerating the urethra when they were removed, or even necessitating a perineal or suprapubic wound to free them. The jaws of the instrument devised by Bigelow are constructed so that there is but little chance of impaction of the calculus. The male blade (*i. e.* the one that slides) has blunt pyramidal projections on the jaw, so that the cusps alone catch the calculus, and when the crushing power is applied and the male jaw is forced against the female the fragments of calculus are shed away right and left down the sides of these minature pyramids,

[1] *Boston Med. and Surg. Journal*, August 24, 1893.

instead of being jammed up flat against the female blade, which is fenestrated only at the base of the curve to admit a spur or septum on the base of the male blade, which precludes any clogging of its heel by fragments. The tip of the female blade is also slightly prolonged, and

FIG. 197.

Bigelow's lithotrite blades open and closed.

curved back, so as to allow it to slip through the urethra with greater ease. The handle of the instrument is cylindrical, and furnished at the end with an egg-shaped knob instead of a wheel, whereby the opening and shutting of the blades is controlled. Just below this knob is a movable collar with which the instrument is locked, and the sliding motion changed for that of a screw; thus the operator, steadying the instrument with his left hand and controlling the power of the instrument with his right, can search for the calculus, grasp it, and crush it without taking his hands off the handle and without having to pause to separate the blades again by unscrewing. Many surgeons still prefer a completely fenestrated instrument in which the male blade slides through the fenestration in the female. Sir Henry Thompson and Keyes advocate such an instrument to do the coarse work of breaking the calculus into large fragments, which should be then further comminuted by means of a smaller-sized solid lithotrite. The greatest care is necessary in the manufacture of these instruments to ensure their strength; to have an instrument break or bend in the bladder is an accident of the gravest character. The blades should be cut from a solid piece of steel and not forged.

The main part of Bigelow's fame, however, in originating the operation of litholapaxy does not solely rest upon his modification of the lithotrite, but upon his method for washing out the calcareous débris immediately after the crushing of the calculus.

Bigelow's evacuator consists of ample-sized catheters, both straight and slightly curved (about 28 or 30 of the French scale for adults) for extracting the débris, and an elastic bulb with a wide-mouthed glass receiver directly attached to the bottom and with a stopcock at the top, and with another at the side connected with the bulb by a tube, which also penetrates the bulb one or more inches. This lateral stopcock can

be attached to the catheter, which is in turn also provided with a stopcock *at the end*. By the stopcock at the top of the elastic bulb the latter, which is termed the "aspirator," can be filled with water. The portion of the tube (wherein is fixed the lateral stopcock), which enters the elastic bulb for some inches, is perforated within the bulb with numerous holes whose aggregrate emptying capacity is greater than the open end of the tube, so that in forcing the water into the bladder it rushes in through these small holes with greater velocity than through the large opening at the end, and thus there is little danger that fragments which have once fallen into the receiver will be drawn up into the large opening and thrown back again into the bladder.

Operation.—The patient is prepared in the usual manner, the rectum emptied by an enema, the pubes and perineum shaved and rendered aseptic. The urine should be drawn and the bladder washed out, and then injected with four to six ounces of warm boracic-acid solution. The patient being thoroughly anæsthetized and placed in the lithotomy position, the lithotrite is introduced in the same manner as the steel sound, except that the surgeon stands on the patient's left. When the point of the instrument reaches the membranous urethra the shaft will stand at right angles to the patient's body; it should be allowed to remain stationary in this position for a few seconds, and then by its own weight it will glide through the prostatic urethra and enter the bladder, the handle of the instrument being gently depressed between the thighs. The beak of the instrument should then be gently pushed forward along the fundus until it touches the posterior wall of the bladder, and as soon as the fluid in the bladder has had time to settle, the blades are slid apart until the male blade touches the neck of the bladder and is then slowly closed. Probably it will be found that the calculus is within the grasp of the instrument. A few gentle turns should then be given to the screw to make sure that the calculus is firmly grasped and will not fly out from between the blades when strong pressure is exerted. If the calculus is not caught by this first manœuvre the beak of the instrument should be turned first to one side, then to the other, and gently opened and closed. If the calculus still eludes the grasp, the instrument should then be turned with the point directly down in order to search behind the prostate. Whenever the calculus is firmly grasped the instrument should be rotated on its long axis so that the blades point upward, and then partly withdrawn so that the crushing shall take place as near the centre of the bladder as possible. By rotating the instrument the operator can make sure that he is grasping the calculus and not a fold of mucous membrane. This process of searching for the calculus, of adjusting the instrument, and then of crushing, is carried on until the whole mass has been reduced to small fragments. Up to this point the operation is lithotrity; now begins litholapaxy, the important modification devised by Bigelow. The lithotrite is then firmly closed and withdrawn, and Bigelow's evacuating catheter introduced. If the straight tube is used, there may be a little difficulty in its introduction. When the point reaches the bulb of the urethra it makes a little pocket on the inferior wall, and should therefore be withdrawn slightly, and then the outside end depressed so as to raise the point up against the upper wall of the urethra; pressure should be exerted downward at the same time on the penis close to the pubis, in

order to relax the suspensory ligament and straighten out the urethra. The evacuating bulb, filled with warm sterilised water, is then connected, and the bubbles of air contained in the catheter allowed to escape through the stopcock at the top of the bulb. Firm, slow pressure is now made upon the rubber bulb, and the water forced gently into the bladder while the tube is steadied with the left hand. After a second's pause, to allow the fragments to settle round the end of the tube in the bladder, the pressure is relaxed, and the fragments are sucked up and may be seen falling into the glass receiver, which, when filled with débris, may be detached and emptied. This process is carried on until no more fragments are brought out. Auscultation over the bladder will usually reveal the sound of the fragments clicking against the tube, and in this way the operator may be pretty sure when the last fragment has been withdrawn.

Surgeon-major Keith of India[1] advocates the finest possible comminution of the calculus, first with a large fenestrated lithotrite and then with a small-sized lithotrite, persisting in the crushing until the calculus is reduced almost to dust or sand. Then, instead of using Bigelow's evacuator, which he maintains is apt to plaster the calcareous fragments against the vesical wall, he utilizes the natural expulsive force of the bladder to evacuate the particles, which are expelled through a large-sized catheter by frequently flushing out and refilling the bladder until the fluid comes away perfectly clear.

The clogging of the blades of the lithotrite is perhaps the only complication of any moment which is at all likely to occur; it very rarely happens if properly fenestrated lithotrites are used. In case this does happen and the blades cannot be freed by rapping them sharply and quickly together several times, then they should be pushed down against the perineum or up against the pubes, and an incision made upon them as in median or suprapubic lithotomy. Owen[2] reports a case of rupture of the bladder in a boy while the evacuator was being used; this, however, was due to the use of a large-sized bulb instead of one adapted for children.

After-treatment consists of rest in bed, milk diet, and moderate doses of quinine, salol, or boric acid. The average stay in the hospital after litholapaxy in adults is about ten days.

Even calculi of large size are at the present day treated by litholapaxy. Buckston-Browne[3] has on several occasions crushed uric-acid calculi weighing over three ounces, and also reports crushing a cystine calculus weighing two and a quarter ounces; such a weight of cystine indicates a calculus of large size, as cystine is a light substance.

Keegan,[4] after reporting 50 cases, which bring his total up to 175, with 5 deaths, lays down the following rules to guide the inexperienced in performing the operation of litholapaxy in boys: The surgeon should be provided with an ample supply of perfectly reliable lithotrites, all of the completely fenestrated pattern, and with cannulæ with serviceable stylets. He should never withdraw a cannula from the bladder nor introduce one unless it be fitted with a stylet. Four ounces (one hundred and twenty-four grammes) of water should be the maximum quantity

[1] *Indian Med. Rec.*, Dec. 1, 1893.
[2] *Lancet*, Mar. 21, 1893.
[3] *Ibid.*, Feb. 22, 1890.
[4] *Ibid*, May 27, 1893.

allowed to be in the bladder at any given moment. The aspirator should be used gently and methodically, and water should not be injected into the bladder while the patient strains. Extreme gentleness and care are essential in practising all manipulations of instruments in the bladder and urethra. The operator should not be in a hurry to finish the operation, and, if possible, he should not leave a grain of débris behind in the bladder. If all these conditions be fulfilled, a large measure of success will be obtained.

Guyon[1] in his last 49 cases of lithotrity has used a retained catheter, keeping it in place for twenty-four hours. In 40 of these cases there was absolute apyrexia, and in the other 9 merely a slight and transitory elevation of temperature. Of the patients 27 had old phosphatic calculi, were obliged to empty the bladder by catheterism, and had been infected for a long time. Guyon remarks that even admitting that fever and cystitis are rare after lithotrity at the present day, this experience demonstrates that the retained catheter may be employed without *causing* vesical inflammation, as used to be thought an invariable consequence. My own experience would not lead me to think it necessary in the majority of cases, but his testimony would lead me henceforth to employ a retained catheter after litholapaxy in old persons with infected and atonic bladders and with enlarged prostate. Almost the only deaths I have ever seen follow the operation have been in such cases, and if castration to secure shrinkage of the prostate were not thought desirable and preliminary, I should certainly feel disposed to employ the retained catheter after the method minutely described in the above article.

Chismore's Modification of Bigelow's Operation.—Chismore has described[2] as follows the modification he has employed in 52 cases: His youngest patient was fifty-one, the oldest seventy-four; average, 66.36 years. Of the calculi, 22 were phosphates, 24 oxalates, 5 urates, and 1 mixed oxalate and urate. The smallest weighed dry 7 grains, the largest 1000 grains; average weight, 149 grains. There were no deaths and no serious complications. He thinks the method especially adapted for cases of senile enlargement of the prostate with a pouched irregular bladder. These conditions, together with the consequent alteration of the relations of the vesical orifice of the urethra, make it impossible to command considerable portions of the cavity of the bladder with the lithotrite, or, indeed, any instrument introduced through the urethra or a perineal incision, besides furnishing hiding-places for the escape and retention of fragments of calculi during litholapaxy. The modifications of the classical operation suggested by Chismore are as follows: 1. Substituting local for general anæsthesia in cases where an anæsthetic is required. 2. Short sittings. Continue crushing only so long as fragments can easily be found. Wash out the pieces, and stop the moment symptoms of exhaustion, spasm of the bladder, or unusual distress occur. 3. Remove remaining pieces after symptoms due to previous operation have subsided, as soon as they can be felt by the searcher—usually within a week—and repeat the process until the bladder is cleared.

It will be observed that the operation thus conducted ceases to be a

[1] *Ann. des Mal. des Org. gén.-urin.*, May, 1895.
[2] *Journ. of Cut. and Gen.-urin. Dis.*, August, 1894.

litholapaxy in Bigelow's sense—*i. e.* the clearing the bladder at all hazards in one sitting—and differs from a lithotrity in that all fragments small enough to pass the urethra are removed as soon as crushed.

As these patients usually have strictures, a period of preliminary dilatation is often necessary. After this, Dr. Chismore (who does not put the patient to bed during the operation nor confine him to the house afterward) proceeds by emptying the bladder, injecting from one to two fluidounces of 4 per cent. solution of cocaine muriate, gently inserting the lithotrite, seizing and crushing the stone. "If during this procedure I become aware," says Dr. Chismore, "as I sometimes do, that quite a large fragment has apparently vanished, I do not make prolonged attempts to find it. It is perhaps in some pouch, or lying in a fold between two projecting knobs of the prostate, or firmly imprisoned in the deep sulcus formed by the bladder-wall doubled upon itself by the intruding gland—in any case entirely beyond the reach of instruments—and there it will remain until it becomes slippery with mucus or in some other way dislodged.

"When no more pieces can be found the lithotrite is removed, a catheter as large as will pass inserted, and the bladder washed with a warm borated solution until the fragments cease to come. The patient is then sent home with orders to keep quiet and warm, and if all goes well to come back in three or four days. In the great majority of cases there are no after-symptoms—the patient is better at once. Now and then difficulty in passing the catheter, due to swelling of the deep urethra, demands attention. The patient's statement is an excellent and reliable guide in case of remaining pieces. Although at first he feels nothing, if a fragment be there sooner or later the old symptoms recur—frequency of micturition attended with spasm, the urine becomes loaded with pus and mucus, he 'feels a stone,' and on search it will be found, usually in the locality where its predecessor habitually rested. As a rule, no anæsthetic is needed to remove such fragments, and after two or three sittings the bladder is cleared. An assistant is desirable, but the operation may be managed alone without much difficulty."

Perineal Lithotrity.—This operation, introduced in its essentials in 1862 by Dolbeau, is described as follows by Reginald Harrison, after an experience of fourteen successful cases: The chief features in connection with the operation are—(1) the mode of obtaining access to the interior of the bladder from the perineum; and (2) the mechanism connected with crushing and evacuating the stone.

From a number of experiments made on the dead subject, as well as from the performance of median cystotomy on the living, it seemed to him unnecessary to do more than to make an opening from the perineum into the membranous urethra at the apex of the prostate, on a grooved staff passed along the urethra, sufficient to admit the introduction of Wheelhouse's small tapering gorget, and subsequently the index finger into the bladder as for digital exploration, or, as is done in the boutonnière or Cock's operation; more than this is not necessary. In Dolbeau's operation direct access to the bladder was obtained by this route, aided by the use of an expanding instrument, by means of which the prostatic urethra and neck of the bladder were dilated. It seemed to Harrison, from some experiments made on the cadaver, that the latter

means of dilatation was not only unnecessary, but was open to the objection that unless used with the greatest care it was possible to inflict serious damage.

Further, he succeeded in demonstrating that by means of crushing forceps, shaped somewhat like the blades of a lithotrite, and not exceeding by actual measurement in circumference that of an ordinary index finger, sufficient power might be provided to crush and assist in evacuating any stone that could be fairly seized in this way. This forceps is provided with a cutting rib within the blades, and the more powerful instruments are fitted with a movable screw on the handle. The fragments may subsequently be withdrawn by means of aspirator catheters passed through the wound or even by the forceps. If care is taken to make the perineal wound correspond in size with the evacuating catheters, which should be of about the size of an ordinary index finger, there is no difficulty in keeping the bladder distended during the necessary manipulations.

Harrison sums up the chief points in favor of this operation: "(1) It enables the operator to crush and evacuate large stones in a short space of time. (2) It is attended with a very small risk to life as compared with other operations where any cutting is done, such as lateral or suprapubic lithotomy, and is well adapted to old and feeble subjects. In a recent address Mr. Swinford Edwards shows that the latter operation for large stones has a mortality somewhat about 50 per cent. (3) It permits the operator to wash out the bladder and any pouches connected with it more effectually than by the urethra, as the route is shorter and the evacuating catheters employed of much larger calibre. (4) The surgeon can usually ascertain, either by exploration with the finger or by the introduction of forceps into the bladder, that the viscus is cleared of all débris. (5) It enables the surgeon to deal with certain forms of prostatic outgrowth and obstruction complicated with atony of the bladder in such a way as to secure not only the removal of the stone, but the restoration of the function of micturition. (6) By the subsequent introduction and temporary retention of a soft-rubber drainage-tube states of cystitis due to the retention of urine in pouches and depressions in the bladder-wall are either entirely cured or are permanently improved. To lock up unhealthy ammoniacal urine in a bladder that cannot properly empty itself after a lithotrity is to court the formation or recurrence of a phosphatic stone. Hence it is well suited to some cases of recurrent calculus.

"It is well adapted for some cases of stone in the bladder complicated with stricture in the deep urethra, as it enables the surgeon to deal with both at the same time. Nor does it expose the patient to the risk which may be attendant where lithotrity is performed with a weakened or permanently damaged urethra."

Intraperitoneal Cystotomy.—For stones complicated with tumors, for encysted stones, for stones in small rigid bladders encroached upon by enormously enlarged prostates, and for stones associated with conditions indicating manual examination of the kidneys, intraperitoneal cystotomy may occasionally be of great value. It was suggested by Harrington of Boston, who describes the technique as follows:[1] "Prepare the patient

[1] *Annals of Surgery*, Oct., 1893.

as for ordinary laparotomy; wash the bladder, if the urine be foul, for several days with a saturated solution of boric acid; distend the bladder gently with this solution at the time of operation; make the abdominal incision from the umbilicus to the pubes, being careful not to open the prevesical space.

"The intestine should be drawn out of the pelvis and the cavity packed with strips of sterilized absorbent cotton covered with gauze, the patient being in the Trendelenburg position. An incision in the median line of the bladder, beginning within an inch from the junction of the abdominal and vesical peritoneum, should be extended backward from two to three inches.

"The incision should at first only include the peritoneal coat, which should be dissected from the muscular coat for a quarter of an inch on either side of the incision. The fluid should now be withdrawn and the incision carried through to the cavity of the bladder. Bleeding may be controlled by hæmostatic forceps.

"Having performed whatever operation is necessary upon the interior of the bladder, and having the hemorrhage under control, the bladder may be closed. The method of closure should be by continuous suture of the muscular coat, the stitches being closely applied. These stitches should not include the mucous membrane; they should be of silkworm gut or silk. The peritoneal coat of the bladder should then be closed by a continuous 'right angle' or by 'Lembert' suture. This gives a double row of stitches. The continuous stitch prevents stretching of the bladder-wall when it is distended, and is a safeguard against leakage. Should there exist a bleeding within the bladder which threatens to interfere with micturition, permanent drainage can be made through the perineum, through the vagina, or by the suprapubic route.

"The intraperitoneal operation does not interfere with suprapubic drainage should drainage be necessary. As a rule, however, drainage will not be necessary except that which can be obtained by the urethra.

"The packing should now be removed from the pelvis and from about the intestines. The pelvic cavity should be wiped out with moist aseptic gauze and the abdominal wound closed. The bladder should be washed gently with boric-acid solution two or three times a day, care being taken not to distend it nor to allow it to become distended with urine."

Choice of Methods.—Various factors enter into the selection of operation for stone. These relate either to the patient or to the calculus.

The choice of operation, so far as the patient is concerned, will be influenced chiefly by—1, age; 2, the condition of the urinary tract; 3, the general state of health. As regards the stone, the important points have reference to—1, its size; 2, its density; 3, its mobility in the bladder.

There are a number of minor factors which will be enumerated. Statistical evidence is of course of the utmost importance. It is most complete as applied to questions of age; less so as regards the other factors. The most recent accessible statistics are herewith embodied.[1]

1. *Age.*—We may arbitrarily divide all cases into three groups: *a*, infancy to puberty; *b*, puberty to middle age; *c*, middle age to old age.

[1] Cabot, *Morrow's System*, vol. i. p. 655; Barling, *Brit. Med. Journ.*, March 9, 1895.

In group *a* we have the following statistical facts to guide us. Perineal lithotomy: 602 cases, 19 deaths—a percentage of 3.1. Suprapubic lithotomy: 637 cases, 84 deaths—a mortality of 13.1 per cent. Litholapaxy: 284 cases, 5 deaths—1.7 per cent. These figures are more impressive because they are not made up from the records of a few exceptionally expert lithotomists, like Ferguson, or Cadge, or Agnew, or unusually skilful lithotrotists, like Guyon, or Keith, or Freyer, but include cases from various sources collected by Cabot, and from the records of six metropolitan and seven provincial hospitals by Barling. These cases have all been operated on since 1878 (the year of the introduction of litholapaxy and of the renaissance of the high operation), and Barling's cases are all included in the five years 1888–92.

The result in favor of litholapaxy is about what might be expected by those who have carefully and impartially watched the development of the operation. But as it is still asserted by many writers and teachers of surgery that in children lateral lithotomy is to be preferred, and can scarcely be improved upon, it seems worth while to state briefly the arguments which appear conclusive in support of litholapaxy.[1] Most of the old arguments against it have lost their force. "Anæsthesia has made the 'extreme sensibility' of the part and the 'indocility' of the patients of little moment. Otis has shown that in children, as in adults, 'the small diameter of the urethra' may be greatly increased with entire safety. He says that the proportionate relation between the circumference of the urethra and that of the penis, which he has already demonstrated in adults, holds good in children. Thus, with a circumference of penis of one and a half inches, as in a child from two to three years of age, the size of the urethra would not be less than sixteen millimetres for every quarter of inch added to or subtracted from the penile circumference. It is but fair to mention that Morelli has called attention to a fact upon which some of the success of the Indian surgeons may depend—viz. the very early age at which the children of tropical and Eastern countries reach full sexual development. This may permit the use of larger instruments, on an average, at a given age than would be possible in Europe or America, and would facilitate and extend the possibilities of litholapaxy.

"Antisepsis during and after the operation has minimized the danger of laceration of the mucous membrane; instruments have been made which are at the same time small enough to permit of their introduction into the urethra and bladder of young infants, and strong enough to deal with very large and very hard calculi. Bigelow has overcome the difficulty of getting rid of the fragments, and the argument from statistics is at least neutralized by the records of Keegan and Freyer."

The argument that recurrence is more common after litholapaxy than after lithotomy is the only one which seems of any moment. Existing statistics certainly show a greater tendency to recurrence after the former operation. But it must be remembered that they apply to patients of all ages, and are thus misleading.

The two principal causes which lead to recurrence are—*a*. The failure to remove every portion of stone at the first operation; *b*. The

[1] With the kind permission of Dr. Louis Starr, I have here summarized the article I recently contributed to his "Text-book of the Diseases of Children."—J. W. W.

new formation of stone in the kidney and its descent into the bladder. In the tables of Mr. Donald Day, based on the records of the Norwich Hospital, the first class included two-thirds of all the cases of recurrence. But circumstances have altered. The employment of a large-sized evacuating-tube, the immediate and thorough emptying of the bladder, the minute pulverization usually possible with completely fenestrated lithotrites, the increased knowledge of the great tolerance of the bladder to prolonged manipulations, if gentle and skilful,—have all combined to place the question of recurrence upon a very different level, and to make the collection of a new set of statistics as to recurrence absolutely necessary before venturing to draw any positive conclusions.

But if, for the sake of argument, we investigate existing statistics on this subject, we find that the great majority of cases of relapse or recurrence have taken place in persons past middle life, and especially in very old persons with enlarged prostates and feeble or atonic bladders. It will be recognized at once that these conditions do not prevail in children. The prostate is undeveloped; the bladder is almost an abdominal organ; no pouch exists at the fundus; sacculation is nearly or quite unknown; cystitis is a comparatively manageable complication; the expulsive power is proportionately greater than in the male adult, in whom a "physiological atony" is not at all infrequent. In addition to the reasons above given for not anticipating the formation of new calculi in children around nuclei of vesical origin, it may be reasonably expected that the conditions favoring the development of renal calculi will be more easily treated and controlled in children than in adults. Certainly among well-to-do people, who can carry out a proper system of diet and medication, it is fair to suppose that the lithic diathesis, of whatever variety, will be more readily combated in children, where diet and drugs and mode of life can be rigidly controlled, than in adults with fixed and often very prejudicial habits. Mr. Cadge expressly states that this was true in his own cases, and adds that he has no personal experience of lithotrity in children.

Keegan has recently (1890) stated that after watching many cases for a considerable time he is convinced that in male children a recurrence of stone does not follow litholapaxy any oftener than it does lithotomy.

Median lithotomy in children, although advocated by some surgeons, is objectionable on account of the greater danger of wounding the bulb of the penis and the difficulties of obtaining space through which to pass the finger into the urethra and the bladder. It is indeed true that the passage of the finger is not absolutely necessary, although it has always been one of the time-honored rules of lithotomy not to withdraw the staff until the finger is in contact with the stone. I have, however, frequently seen Dr. Agnew, when operating on young children, introduce a pair of very small lithotomy forceps along the groove of the staff, separate them and seize the stone, and then, after removal of the staff, extract the calculus, the finger never having been in the bladder. I have used the same manœuvre myself with success. It must be remembered, however, that there is here almost the same possibility of leaving débris or unnoticed stones in the bladder as in the case of litholapaxy. If the stone be soft and break down under the forceps, or if there be multiple

calculi, the surgeon is dependent on the touch and sound elicited by the vesical explorer, just as after the latter operation.

If, then, the introduction of the finger be dispensed with in either median or lateral lithotomy in children, the operation loses one of its alleged advantages—viz. the assurance of the absolute removal of all calculous fragments. If it be insisted upon, it constitutes in a small proportion of cases an unavoidable source of both difficulty and danger. Sir William Ferguson, Keith, Thompson, Cadge, and many others have recorded occasional trouble with this step of the operation. The latter surgeon remarks, apropos of Ferguson's case, "He was a master of the art of operative surgery; if the difficulty occurred to him, we may conclude that it is not unlikely to occur to any of us."

Lateral lithotomy in children, in addition to the special difficulty due to the smallness of the parts, the high position of the bladder above the pelvis, the delicacy and mobility of the deep urethra and the vesical neck, has one possible contraindication which should not be lost sight of. If the incision be prolonged a little too far backward, the left ejaculatory duct can hardly escape division and subsequent obliteration; and, although this may not be a serious accident in cases in which the integrity of the opposite half of the genitals, the testicle, duct, etc., is unimpaired, yet it leaves the patient entirely dependent on that one side for fertility if not for potency. Mr. Teevan has reported four cases of sterile husbands among lithotomized patients. Langenbeck and Sir William MacCormac have called attention to the same danger, and Keegan believes the lateral operation to be frequently followed by emasculation. Dennis quotes Dr. Charles Leale in relation to several cases coming under his own observation in which such patients grew up with shrill voices, atrophied testicles, absence of hair upon the face, etc.; in fact, with all the characteristics of eunuchs. Horwitz has reported[1] two cases of sterility and impotence following lateral lithotomy performed in one case at the age of twenty-three, in the other at the age of twenty-five. In one case the impotence was not permanent.

The evidence as to this point is as yet fragmentary and inconclusive, but is of sufficient importance to deserve careful consideration, although Ehrmann characterized the fear of sterility as a "bugbear." The objections to perineal lithotomy in children are, however, at least as weighty as any that have been urged against litholapaxy.

Cabot says:[2] "An ample experience has shown that the urethra and bladder of a child will tolerate a considerable amount of instrumentation. It would therefore seem wise to use litholapaxy for all small stones or stones of moderate size (from one and a half to two and a half centimetres in diameter), and for stones larger than this to do lateral lithotomy, except when they are very large (three and a half centimetres and upward in diameter), and then suprapubic cystotomy is to be resorted to."

The ease with which bimanual palpation can be practised in children with the finger in the rectum and a hand on the abdomen makes it possible to judge pretty closely the size of the stone, and thus select intelligently the best method for its removal.

Basing my opinion on the facts mentioned in this paper and on

[1] *Journ. of the Am. Med. Ass'n*, April 8, 1893. [2] *Morrow's System*, vol. i. p. 662.

my personal experience, I believe the following conclusions to be justifiable:

1. In every case of calculus in male children litholapaxy, on account of ease of performance, low mortality, speedy recovery, and absence of danger of emasculation, should be the operation of predilection, division of the meatus being freely resorted to if that portion of the urethra offers an obstacle to the introduction of instruments.

2. The lithotrite and evacuating-tube should be of a size which can be inserted into the bladder without much effort or over-distention, and great gentleness should be observed in passing these instruments. Keegan says: "When I advocate litholapaxy as being the best operation, in my opinion, for the great majority of stones occurring in male children and boys, I do so with a very important reservation—viz. that no one should attempt to perform it in boys until he has first gained some practical experience of it in adult males. The surgeon who meets with cases of stone only at rare intervals during his career will be acting more wisely if he adheres to lateral lithotomy or suprapubic cystotomy. It is his misfortune, and not his fault, that he has not been afforded many opportunities of gaining a practical familiarity with the use of the lithotrite."

3. The instrument should be withdrawn and reintroduced as seldom as possible, the stone being finely pulverized before the lithotrite is taken out at all. In seeking for or attempting to seize the stone care should be taken to avoid such wide separation of the blades as will bring the male blade in frequent contact with the vesical neck. The crushing should invariably be done only after rotating the blades into the centre of the bladder. Every particle of the calculus-dust should be evacuated.

4. Rest in bed, milk diet, and sterilization of the urine by boric acid or salol given internally, both before and after the operation, are valuable adjuvants. During the operation every antiseptic precaution should be observed. Southam very properly emphasizes the importance (*a*) of this preliminary sterilization of the urine by the administration of salol and boric acid, and if need be by irrigation of the bladder; and (*b*) the avoidance of shock by thorough protection of the patient against surface chilling.

5. The exceptional cases of calculi which are both large and hard may be best treated by suprapubic lithotomy, but neither unusual size nor a moderate degree of density should of itself alone be thought positively to contraindicate litholapaxy.

6. Perineal lithotomy has now a very limited field, and should be employed chiefly in those cases where the stone is thought to be of small or medium size, and where no lithotrite, however small, can be introduced with safety.

In group *b*, viz: puberty to middle age, the statistical evidence is as follows: Perineal lithotomy, 226 cases, 22 deaths—9.7 per cent.; suprapubic lithotomy, 159 cases, 18 deaths—11.3 per cent.; litholapaxy, 485 cases, 22 deaths—4.5 per cent.

Litholapaxy is evidently the operation to be first thought of, but there are cases in which it is undesirable or impossible. These may be enumerated as follows: As regards the *patient*, the contraindications to

litholapaxy are—1. A tight fibrous stricture of the deep urethra. Divulsion as a preliminary to the litholapaxy has been recommended in these cases, but in my opinion is dangerous. Median perineal lithotomy or perineal lithotrity is to be preferred, in either case with full division of the stricture. 2. A severe chronic cystitis. In patients of the age we are now considering one of the perineal operations followed by drainage is often preferable. It must be understood, however, that the cystitis is of the interstitial variety and is really severe, as shown by hæmaturia. vesical spasm, tenesmus, etc. An ordinary cystitis does not contraindicate litholapaxy. 3. For avoiding the use of an anæsthetic there may be special reasons connected with visceral conditions—fatty heart, valvular disease, great atheroma with previous apoplexy, hæmoptysis, etc. In this case either the method developed by Chismore (see p. 589) must be used or lithotomy selected. Where chronic nephritis, diabetes, or other constitutional diseases are present, preference should be given to litholapaxy. As regards the *stone* contraindications are—1, a nucleus consisting of a foreign body which cannot be comminuted (as a pipe-stem, a lamp-wick, a piece of catheter) and too large to be evacuated whole; 2, an encysted stone almost always requires suprapubic extraction; 3, great size and extreme hardness. These latter factors are not nearly so important now as they were once thought to be. A few stones, but very few, come in this category. Extreme hardness and small size indicate perineal lithotomy. Great size, combined with exceptional hardness, is the only clear indication for suprapubic lithotomy in adults of middle age, except the presence of a vesical diverticulum containing stone or the existence of some intravesical growth requiring operation at the same time.

In group *c*, viz.: that of old age, the evidence from statistics is: Perineal lithotomy, 69 cases, 13 deaths—19 per cent.; suprapubic lithotomy, 91 cases, 17 deaths—18 per cent.; litholapaxy, 581 cases, 40 deaths—7 per cent.

It is apparent that it is in old age that Bigelow's operation has accomplished its greatest good. The especial contraindications (in addition to those mentioned in group *b*) are—1, enlargement of the prostate; 2, atony of the bladder. Perineal operations have proved eminently dangerous to men well stricken in years; hence suprapubic lithotomy is to be preferred, inasmuch as it admits of a coincident prostatectomy if the general health warrants it. I am of the opinion that in the future many operators will do as I have done, and secure shrinking of the prostate and more or less complete obliteration of the post-prostatic pouch by double castration before attacking the stone.[1]

Barling's synopsis[2] of his tables and comparison with Thompson's is pertinent to this subject of choice of method:

Thompson's Tables (operations from 1790 to 1840).

Age, one to eleven, inclusive: 850 cases, 49 deaths (1 in 17) = 6.0 per cent. mortality.

Age, one to forty-eight, inclusive: 1365 cases, 114 deaths (1 in 12) = 8.3 per cent. mortality.

Age, forty-nine and upward: 462 cases, 115 deaths (1 in 4) = 25.0 per cent. mortality.

[1] See *Annals of Surgery*, July, 1895.

[2] *Loc. cit.*

...287 cases, 229 deaths (1 in 8) = 12.5 per cent. mor-

Barling's Tables (operations from 1888 to 1892).

Age, under ten: 166 cases, 14 deaths (1 in 11) = 8.4 per cent. mor-

under fifty: 377 cases, 32 deaths (1 in 11.8) = 8.4 per cent.

and upward: 236 cases, 29 deaths (1 in 8.0) = 12.5 per mortality.

t all ages: 613 cases, 61 deaths (1 in 10.0) = 10.0 per cent. mor-

nparison of these figures emphasizes the fact that the general ity of stone operations is reduced. It shows further that the ion is due to the greater safety with which operations are now med after fifty years of age; but it appears to show also unmis-ly that operations for stone in children are attended with a greater ality than they were fifty years ago. Barling says: "This, if it ue—and I have endeavored to avoid putting any unfair construc-on the figures—can only be due to the introduction of lithotrity suprapubic section. Reference to the first table shows that to the the enhanced mortality must be ascribed.

This farther inquiry therefore confirms the opinion I expressed in ormer paper, already referred to, that lateral lithotomy and litho-y are safer operations in children than the suprapubic is at present, hat if the last-mentioned is to be adopted as a routine procedure in uture, it must be shown that it gives better results than it does now.

To return for a moment to the mortality of suprapubic section in adults, I can only speak of general impressions gathered from the statistics and from my own operations. So far as these go, they leave no doubt in my mind that where a cutting operation has to be performed on an elderly person, say above fifty, suprapubic section is safer than perineal, but it should be resorted to only when lithotrity is for any reason unadvisable. In the middle period of life, although I personally prefer to perform litholapaxy, I believe the mortality of the three operations is very similar."

Tumors of the Bladder.

Etiology.—The etiology of tumor-formation on the walls of the bladder is as obscure here as it is elsewhere. The secondary factors which relate to the origin of vesical neoplasms are *Heredity*, *Sex*, and *Age*. That there may be an hereditary predisposition to new growths here, as elsewhere, seems highly probable, but this view is strongly opposed by many surgeons. Males are mainly the victims of bladder-growths, and the tendency thereto certainly increases with advancing years. Irritation of the walls of the bladder apparently does not induce tumors; chronic cystitis may exist for years and yet no neoplasm form; vesical calculi likewise keep up a constant irritation over long periods of time, but still there may be no evidence of a tendency to new growths. When, however, the question of age is considered, it will be found that by far the greatest number of cases occur after middle life.

Out of 113 cases collected by Watson, 71 were aged forty years and over; in 100 cases of cancer also collected by him the youngest patient affected was thirty years old; and in 15 cases reported by Fenwick 13 were past forty. Myxomatous forms, however, are exceptions to this rule, occurring most frequently in early life. Sex likewise undoubtedly has some etiological bearing on vesical tumors, males being more disposed to be affected than females. Out of 315 cases of vesical tumors of all sorts collected from different authors, 228 occurred in men.

Fenwick is of the opinion that the irritation from residual urine is sometimes a causative factor.[1]

As regards frequency, vesical tumors are comparatively rare; Galt gives their frequency as .39 per cent. of all tumors, and they enter into all affections of the bladder in the proportion of only 3.2 per cent.

The most common location of all the varieties of tumor of the bladder is the lower third of the posterior wall, either just behind the urethral orifice or within the vesical trigone, and their tendency is to enlarge toward the neck of the bladder. They may be occasionally situated on the lateral walls, but it is exceptional to find them on the anterior surface. Fenwick estimates that in 43 per cent. of all cases where vesical papilloma are found they occupy a position at the border of the right ureteral orifice; in 26 per cent. of cases they are situated at the left ureteral orifice, and in 10 per cent. they lie between the ureters.

It may be said, in a general way, of tumors of the bladder, that when rounded, polypoid, or filamentous they are usually benign, and when flat they are malignant; but all tumors within this viscus have a tendency to assume a papillomatous or villous surface; the embryonic relationship between the allantois and bladder has been suggested as an explanation of this fact. They may grow from the bladder-wall by a pedicle either filamentous or stout, or may be sessile and infiltrate all the coats extensively, rendering extirpation most difficult because the actual zone of infiltration will greatly exceed its apparent limit.

The relative frequency of benign and malignant vesical growths has been the subject of much discussion of late years. Sir Henry Thompson maintained in 1888 that, of all varieties, the papilloma, a benign growth, was that which most commonly affected the bladder. Fenwick is of the opinion that this statement is not borne out by statistics of the operations for removal of vesical growths, which show a large percentage of recurrences. In a series of 20 cases operated on by him, only 2 were found to be benign, and in searching through the museums of Europe he found, without difficulty, from 150 to 200 cases of vesical carcinoma, but only about 50 specimens of undoubted papillomatous growth.[2]

Varieties of vesical tumor:

Benign . .	Papilloma. Myxoma. Fibroma. Myoma.
Malignant	Sarcoma. Carcinoma.

[1] *Brit. Med. Journ.*, July 6, 1889.

[2] *Ibid.*, May 4, 1889.

Of the benign growths, papilloma occurs most frequently, and next to it stands the myxoma. Cancer is more often found than sarcoma; the number of recorded cases, however, of sarcoma of the bladder has somewhat increased of late years, and it is no longer considered as among the rarer forms. There are certain other benign growths, such as angeioma and cysts, dermoid and hydatid, which are so seldom encountered that they scarcely need more than a mere mention. Indeed, it is a matter of much doubt whether they are true vesical growths or merely involve the bladder in their development from contiguous parts.

Papilloma.—The true papillomata of the bladder may be either single or multiple, sessile or pedunculated. They are more often pedunculated, however, and consist then of a well-defined pedicle with a more or less arborescent branching at the top; these branches terminate in tufts of villi, giving to the whole growth the distinct appearance of a cauliflower. Each branch is made up of a fine capillary loop, much like that of an intestinal villus, and a fibrous or muscular framework covered with a thick coating of the polymorphous epithelium of the bladder-walls. The mucous membrane round the base of these growths is rarely infiltrated, so that their permanent removal is easy.

Another form which papilloma may assume is that in which the papillæ arise in groups directly from the mucous membrane, and have the appearance, when the papillæ are slender, of branches of hair, the filaments floating out into the surrounding fluid in waving masses. Their surface is granular, but they have a firmer consistence than the preceding form (Tuffier). The sessile papillomata have the same histological construction as the pedunculated forms, their only difference being that the base is spread out over a greater extent, and the papillæ are short and thick and lie close to the surface.

Warren says: "Papilloma may occur at any period of life. Watson, in a collection of 89 cases, found 59 in males and 30 in females. In the male 21 cases occurred between the ages of sixty and seventy, and 35 between the ages of thirty and sixty. In the female 17 occurred between thirty and forty, and 12 after forty. Thompson describes the hard variety as fibro-papilloma, and the soft form as fimbriated papilloma. He reports several cases of fibro-papillomata removed from the bladder through the median incision in the male and through the urethra in the female, all of which cases made a good recovery with permanent cure. The tendency of papilloma of the bladder to bleed is one of its most marked clinical features. Papilloma of the bladder may be combined with carcinoma, in which case characteristic epithelial cells are found in the base of the tumor in the bladder-wall."

Myxoma.—Tumors of this variety are much rarer than the papillomata. They usually are situated near the neck of the bladder, and cases are on record of their slipping through the urethra and of even appearing at the meatus urinarius in the female. They are more frequently pedunculated than sessile, often multiple and somewhat soft in consistence. In structure they are much like the papillomata, except that their stroma is infiltrated with a mucoid substance and held together with meshes of connective tissue. They might also be classed as fibromata undergoing mucoid degeneration. They are of rapid growth, and are more often found in the young than in those past middle life.

FIBROMA.—Tumors of this variety in the bladder are excessively rare. They resemble in structure fibromata formed elsewhere in the body, and are generally sessile; they grow from the submucous coat of the bladder and are covered with unaltered mucous membrane or villi. Fenwick has found fibroma and carcinoma coexisting in the bladder.

MYOMA.—Myomata of the bladder were supposed by Virchow to be merely prostatic outgrowths, but Belfield has demonstrated that there may be myomata of the bladder pure and simple. They are seldom pedunculated, but are protruded from the muscular coat, often appearing on the outside of the organ as well as in the interior, and sometimes attain a large growth, sufficient to be mistaken for a uterine fibroma.

SARCOMA.—Tuffier quotes Fenwick, who has collected 50 cases of vesical sarcoma, as saying that in children these growths are often multiple, sessile or subsessile, generally polypoid in form; in the adult they are more often simple than multiple, and are pedunculated in only 10 per cent. of cases. In 34.5 per cent. of cases they are of the round-celled variety, and in almost 17 per cent. spindle-celled. They attain a considerable size, sometimes that of a fœtal head. They are generally composed of purely sarcomatous elements, yet villous papilloma degenerating into sarcoma have been observed.

CARCINOMA.—It is now a well-established fact that primary cancer of the bladder occurs both as alveolar carcinoma and epithelioma. Barling has collected 27 cases of the former and 47 of the latter;[1] Fenwick also reports 9 cases of epithelioma and 3 of carcinoma.[2] These forms, however, although differing in minute structure, are in appearance hardly distinguishable one from the other. Carcinomata are elevated and somewhat round in shape, and have a granular, occasionally ulcerated, surface, with a broad base and prolongations extending some distance into the coats of the bladder. They are usually situated on the lower third of the posterior wall or in the vesical trigone. Bland Sutton says that from the habits of the disease it might be anticipated that in a certain proportion of cases it would begin at the orifices of the ureters; and this is actually the case. Epithelioma has a dense indurated base and a friable ulcerated surface; it is often multiple and of various sizes. Vesical carcinomata are of slow growth and have a decided tendency to become generalized. In a series of 27 cases of epithelioma Barling found extravesical extension of the growth in 26; of these, 11 consisted of glandular enlargements, either iliac or abdominal, and 6 were involvements of the kidney, the lung, and the liver. In 15 cases of alveolar carcinoma Tuffier found 3 cases of extension to neighboring organs, 11 cases of glandular infection, and 1 case of perforation of the bladder from ulceration.

Warren thinks[3] that there is no way of distinguishing clinically between cancers of prostatic origin and those arising in other regions of the bladder. He adds: "The precise origin of carcinoma at the neck of the bladder is indeed difficult to determine, and even those carcinomata situated more posteriorly at the base of the bladder are uncertain in their origin, as the middle lobe of the prostate may have prolonga-

[1] *Annals of Surgery*, 1880. [2] *British Med. Journ.*, May 11, 1889.
[3] *Surg., Path. and Therap.*, 1895, p. 694.

tions extending some distance into the walls of the bladder, and the disease may be found to spring from these glandular bodies, as in a case reported by Marchand. The epithelium of the acini of the prostate is a short cylinder epithelium, and in the deeper, more spongy portions of the prostate it is cubical. A small-cell carcinoma with a glandular arrangement of the cells in the alveoli is strongly suggestive of prostatic origin. There are, however, forms of carcinoma that spring from the bladder-wall directly, although Klebs claims that such do not exist. Bode found that in 30 cases of cancer of the bladder 14 were in women. Ord describes the villous cancer as the commonest form."

Although, as might be expected, we have seen that in many cases extension of the disease to the iliac and abdominal glands and thence to the abdominal viscera occurs, extension to neighboring organs appears to be rare. Watson quotes Barling[1] to the effect that in only 3 out of 15 cases of carcinoma of the bladder did extension occur to neighboring organs; and in 9, in the same series of cases, secondary deposits were found in other organs. Of 49 cases 33 had, as secondary changes, hydronephrosis or pyonephrosis, or both.

Watson adds: "The remarkable tendency of carcinoma of the bladder to remain localized for very long periods has been commented on by various writers, and is generally explained by the absence, according to some investigators, or by the meagreness, according to others, of the supply of lymphatic channels in the bladder. Barling[2] quotes Hoggan with reference to this matter as follows: 'There is but one set of lymphatic vessels over the bladder except at the trigone. This single layer commences on the deep or mucous surface of the muscular coat, beginning as loops or chains around the smaller arteries or veins within that coat, as though destined to absorb their exudations rather than those of the mucous membrane. These lymphatics concentrate into two main sets, one going back to the neck of the bladder, the other toward the urachus.' These are said by the text-books to empty into the internal iliac glands, but Hoggan says this is incorrect. At the trigone there is a second set of purely collecting lymphatics arising in the mucous membrane and connecting with the deeper set. This lack of direct connection of the larger portion of the lymphatic channels with the mucous membrane explains the failure of the neighboring glands to become involved in some cases or their tardy infection in others. This also explains the extraordinarily long course of the disease that has been noted."

Rare Forms of Tumors.—Angeiomata have been found only two or three times; lymphadenomata have been observed once by Carron. Dermoid cysts have been reported several times, but probably they are not truly of vesical origin, and should be classed rather as paravesical growths. This is true also of hydatid cysts.[3]

Symptoms of Vesical Tumor.—The symptoms which arise from the existence of a tumor in the bladder may be generalized under two heads —namely, *hæmaturia* and *pain*. In a certain number of cases, however, the disease may escape all notice, and a vesical tumor may be discovered merely by accident at an autopsy. In the majority of cases

[1] *Birmingham Med. Rev.*, March, 1890. [2] *Op. cit.*
[3] Tuffier, *Congrès de Chirurgie*, 1891, p. 569.

the symptomatology is clear, and consists at the onset of profuse hæmaturia—so profuse, in fact, as possibly to result in speedy death. The presence of blood in the urine may, however, be noticed for months, even years, before any grave symptoms arise. It may be constant or it may cease for long periods; seven years have been known to elapse between the first and second hemorrhage from the bladder. During the interval the urine becomes clear and healthy in appearance, and often no pain whatever is experienced at any stage of urination, either before or after. The hæmaturia comes on spontaneously, and the patient is at a loss to explain it on any grounds of injury or over-exertion; the hemorrhage frequently takes place during the night when the bladder is comparatively at rest. It may be said, therefore, that while hæmaturia is a symptom of many other disorders of the genito-urinary tract, when it arises from the presence of a vesical tumor it is characterized by its abundance, by its freedom from pain, except late in the course of the disease, and by its apparently spontaneous origin and sudden and complete cessation for considerable intervals; it is influenced neither by rest nor by the position of the patient. Urination is not painful unless, as only occasionally happens, it is interrupted by the passage of a clot of blood. In employing the two-glass test it will be found that, although all the urine is colored by blood, the second portion—in other words, the "strippings" of the bladder—will be decidedly of a deeper tinge. Small clots may be passed with the urine, and may be either red, black, or decolorized; they may possibly, but rarely, be large enough to cause stoppage of the urethra and produce a retention so complete as to necessitate operative intervention.

The degree of the hemorrhage is no indication of the size of the growth. Small papillomatous growths may often provoke a hemorrhage so profuse that the patient is reduced to the last degree of anæmia.

Fibrinuria, described by Ultzmann, Stein, and Küster as occurring in cases of vesical tumor, is characterized by a somewhat orange color of the urine and by the formation of coagula which cling to the vessel into which the urine is passed. This is due to the exudation of the fibrinous elements alone of the blood from the edges of the tumor, and is a hemorrhage only in part. It is of somewhat rare occurrence.

The urine may also contain fragments of the growth. This is important evidence in the diagnosis of vesical tumor, but from a microscopic examination of these fragments there is but little knowledge to be gained in reference to the character of the growth. The discharge of these fragments is likely to be accompanied by an increased hæmaturia; but, on the other hand, Guyon has called attention to a case in which no hemorrhage occurred, although fragments in abundance of the vesical tumor were discharged. Watson places no little diagnostic value on the quantity of epithelial cells found in the urine. He has found the number of such cells of a great variety of shapes and with large nuclei much greater in cases of tumor than in any other simple ulcerative or catarrhal process.

Pain is a variable symptom, often not manifesting itself throughout the course of the disease, or else only as a late symptom. It may arise from the tumor, and be associated with it only when cystitis has developed. When once it has set in, it becomes an exceedingly severe symp-

tom. It is felt in the hypogastrium, and may be referred to the external genitals, to the thighs, and to the rectum. It is usually worse just at the close of urination. When the pain is not produced by a cystitis nor by retention due to clots, it comes on late in the disease, and is an indication that the tumor is becoming generalized (Tuffier).

It is the opinion of Gross[1] that if hæmaturia, after long intervals of rest, is not preceded by pain and irritability, the probability is that the growth is benign; if irritability and pain appear first, the growth is usually malignant. Fenwick[2] thinks that the onset of hæmaturia is determined more by the softness and delicacy of the growth and the degree of traumatism to which its position in the bladder renders it liable than by its benign or malignant character. Furthermore, the pain and irritability do not depend so much upon its nature as upon its power to excite reflex action. A firm, benign growth situated near the orifice, or pedunculated, so that it becomes engaged in the urethra, will excite pain at an early period.

Physical Signs.—Bimanual palpation through the abdominal walls and through the rectum or vagina often makes the diagnosis clear in cases of cancer of the bladder where induration and infiltration of the vesical walls have taken place to a considerable degree; but when the growth is small and of a papillomatous nature, the results of this manipulation are negative. In performing it the bladder should be empty and the patient placed in dorsal decubitus with the abdominal muscles relaxed. The region posterior to the prostate gland is then explored by the finger in the rectum, while the abdominal walls just above the pubis are pressed firmly downward. Enlargement of the prostate will make this form of investigation impossible or nearly so.

Sounding also gives very negative results except in the hands of a most practised operator. Large, hard growths are easily detected, but small and soft ones, especially if situated at the vesical neck, are impossible to detect with a sound. Rugæ and reduplications of the mucous membrane are often misleading and give rise to errors in diagnosis.

The improvement in the electric cystoscope of the present day, together with the comparative safety of the suprapubic operation with due antiseptic precautions, has in great part done away with the method of diagnosis by digital exploration, of which Sir Henry Thompson has been so strong an advocate. The exploration just mentioned consists in making the usual median incision in the perineum, and inserting the finger into the bladder through the membranous and prostatic urethra. The surface of the mucous membrane can then be thoroughly explored, and growths, however small, can be recognized, and, if advisable, removed through the wound; or this exploratory wound may serve for drainage after a suprapubic operation. The objections to this means of diagnosis are that it cannot be employed in cases of marked prostatic hypertrophy. Fenwick[3] has compared the two methods of digital exploration and cystoscopy as follows: 1. Digital exploration is a cutting operation necessitating confinement to bed; cystoscopy can be performed systematically and rapidly in private or in out-patient practice. 2. The former requires an anæsthetic; in the latter, it is not absolutely necessary, although it is

[1] *Diseases of the Urinary Organs*, p. 146. [2] *Brit. Med. Journ.*, May 4, 1889.
[3] *Ibid.*

best to resort to it in females, *ex gratiâ modestiæ;* also in tuberculosis or similar cases, where the prostatic urethra is hypersensitive; and also in order to make a leisurely diagnosis so as to determine the expediency of operating. 3. Digital exploration is not absolutely free from risk of hemorrhage, and frequently a hypersensitive scar or a fistula is left in the urethra; cystoscopy, if gently conducted, is as free from danger as is ordinary catheterism or sounding. 4. In most cases the educated eye is to be preferred and to be trusted rather than the finger. 5. The cystoscope often affords a sound prognosis and intimates the expediency of operation; it also points out the path best suited for access to the growth. 6. It is true that digital exploration allows of subsequent drainage, but it has not been proved that drainage is always necessary.

Sir Henry Thompson[1] thinks, on the other hand, that the claims laid down for the electric cystoscope are too sweeping, and that it does not furnish a sufficiently accurate knowledge in every case to decide the question of operation.

The method of conducting a cystoscopic examination has been described above, but it may not be out of place here to give a few of the misleading appearances of the diseased and of the healthy bladder, which Fenwick[2] details from a long experience with that instrument. In the healthy bladder the ureteral cone may be often mistaken for a small sessile growth, especially if it is slightly prolapsed, as it frequently is. The jet of urine which may be seen issuing from it at rhythmic intervals will determine this point. Again, when the healthy mucous membrane is thrown into folds by the contracting muscular coats, it forms rugæ which when seen in profile through the cystoscope may be readily mistaken for rows of papillomata. When the prism is turned so that it faces them directly, the mistake is detected. In the bladder affected with a hemorrhagic cystitis, this deceitful appearance of the rugæ is even more pronounced; and in certain forms of chronic cystitis, when the mucous membrane becomes swollen and gelatinous, it is ridged in patches and gives much the appearance of polypoid growths. Phosphates and encrusted growths often appear exactly like calculi, but as soon as the instrument touches them the diagnosis is clear. Hemorrhages form elongated oval elevations often very similar to epitheliomata, but they are usually surrounded by smaller hemorrhagic spots and streaks, and their surface is blurred and filamentous. Tuberculosis is one of the most difficult and most important diseases to diagnose in the bladder. In every stage of its development it counterfeits those diseases for which the examination has been conducted, and in order to make a correct diagnosis the most careful scrutiny and accurate observation are necessary.

A differential diagnosis between certain forms of cystitis and neoplasms of the bladder is not always easy. Guyon[3] has founded on the following case some diagnostic rules worthy of attention: A man aged sixty-three years had gonorrhœa at twenty-three, lasting six weeks; there was no other urinary history. About eighteen months before coming under observation undue frequency of urination was noticed. For a long period there were no other symptoms; pain, hæmaturia,

[1] *Diseases of Urinary Organs*, 1888. [2] *Ib. ut supra.*
[3] *Annales des Maladies des Organs génito-urinaires*, April, 1895.

and pus were absent. In the last six or seven months pain had appeared, which either occurred during urination and ceased at the end of the act, or was felt between the acts of urination, was in the region of the anus, and made sitting uncomfortable. At this time a metal instrument was passed; afterward hæmaturia was almost constant, with occasional intervals of one or two days. All of the symptoms had increased in severity, and in addition several small stones were expelled. There was never any slowness or other difficulty in urination. The hæmaturia had always been terminal, showing itself at the end of urination. It had never been influenced by exertion or repose. Finally, months after the original symptoms, the urine became purulent. From this time the symptoms were similar to those of cystitis. It was never possible to influence favorably the course of the case by local treatment; there was not even temporary amelioration—in itself a useful observation in establishing the diagnosis of neoplasm. All the symptoms finally increased in severity. The bladder became tender to the touch of the finger in the rectum, and bimanual examination showed the right half of the bladder to be thickened and indurated, the affected portion having a hard border. The diagnosis of a tumor infiltrating the bladder-wall was, of course, then easily made. It was impossible to employ the cystoscope, because the bladder would not retain sufficient fluid and the hemorrhage made any view impossible.

The symptoms in this case, apart from the late development of vesical thickening appreciable to the touch, are valuable only by considering the order of their appearance and succession. The successive appearance of single symptoms strongly points to vesical tumor; the immediate association of several symptoms is the rule in cystitis. In the latter the appearance of pus is never long delayed; in tumors it is often delayed. In tumors that infiltrate the bladder-wall, in contradistinction to pedunculated neoplasms, hemorrhage may be a late symptom, while, on the other hand, the irritation of the muscular wall induces frequent urination at an earlier period than in tumors with a pedicle. Hæmaturia, intermittent or profuse and lasting a long time, without other symptoms, is always suggestive of vesical tumor rather than of cystitis. There may be little hemorrhage in some extensive tumors of the bladder, but every neoplasm of the bladder must at some time be associated with more or less bleeding, usually more than in cystitis. In any case in which doubt exists, if the usual treatment for cystitis be not followed by benefit, a tumor is probably present.

Prognosis.—The early symptoms of tumors of the bladder, like all other diseases, give no sure indications of the length of time which must elapse before a fatal issue, but the fatal issue is sure to come if the tumor be not operated upon; the death-warrant is signed and sealed; its time of delivery is alone unknown. Three to five years is probably as near an average length of life as it is possible to prognosticate, after the first onset of the disease, if it remain unalleviated. Patients may die, however, from severe hemorrhages within the first few months or they may live many years. Guyon has noted a case in which characteristic symptoms had existed for twenty-seven years before death, and Budor has reported another in which the patient died twenty-four years after the first symptoms.

Treatment.—Palliative treatment of vesical tumors consists, first, in relieving the pain, or in excising portions of the tumor which obstruct the outflow of urine, or in permanent drainage of the bladder. The relief of pain may be accomplished by means of opium, and also, when possible, by removing the direct cause of the pain when that has been started by cystitis. For this latter purpose permanent drainage of the bladder through either a perineal or suprapubic opening and frequent irrigation with mild antiseptic solutions may be employed.

Operative Treatment.—When the growth is benign, the treatment is excision in all cases, and this is to be accomplished by three methods —namely, through the urethra, through a perineal wound, and through a suprapubic opening. The extraction of growths through the urethra is generally accomplished with the aid of a broad-bladed lithotrite. The exact locality of the growth is first determined by means of a cystoscope, and then the lithotrite is inserted and the growth seized, twisted off its pedicle, and withdrawn. Polypiform and small pedunculated growths are the only ones suitable to this means of removal. The operating cystoscope of Nitze may be also employed for this purpose; the risk of seizing a fold of mucous membrane instead of the tumor is thereby greatly lessened.

The perineal opening as a means of removing vesical growths is losing ground. It is proper to state, however, that the operative mortality is less and that the results are often brilliant. The incision is the same as for lithotomy, and the tumor is extracted by means of flat-bladed, fenestrated forceps and twisted off or snipped off with scissors. The surgeon is at the disadvantage of working somewhat in the dark and of relying upon his sense of touch rather than his sight. The favorite method at the present day is removal through a suprapubic opening. The surgeon can take in at a glance the condition of the whole mucous membrane of the bladder and operate intelligently. The operation is conducted in exactly the same manner as in suprapubic lithotomy, which has been described above. Pedunculated growths may be cut off cleanly and sessile growths of benign character curetted away. Thompson's forceps of special shapes, and Watson's "scissors cautery" are often useful during these operations.

Where an exceedingly large growth, or stone, or an adherent vesicopubic peritoneal fold, or a rigid bladder introduces special difficulty into the operation and renders a large cut desirable, Helferich in 1888 proposed to resect partially the symphysis pubis.

Langenbuch, also in 1888, proposed another route to the bladder—the "sectio alta subpubica"—exposing the anterior surface of the bladder by an incision between the pubic arch and the symphysis. He claims, as advantages, good drainage, avoidance of the peritoneum, and lessened risk of urinary infiltration. I have never tried the procedure, but both the history of his own cases and theoretical considerations make it seem unlikely that it will ever be generally adopted.

Results of Operation in Benign Growths.—Thompson's figures show that cure resulted in 7 cases out of 41 (6 papillomata and 1 myoma): 15 deaths occurred in the series, but in only 2 or 3 were the growths unquestionably benign in character. In 19 cases no recurrence had taken place during periods varying from a year to four years, but they

were not yet included among the permanent cures. In small pedunculated growths the prognosis ought to be favorable. In larger and very vascular growths, even in those which give no microscopic evidence of malignancy, recurrence takes place in a considerable proportion, doubtless from incomplete extirpation at the time of operation.

Results of Operation in Malignant Growths.—A careful search through recent literature fails to show a single case wherein all the conditions essential to a perfect cure are to be found.

Resection of the bladder for malignant disease has been adopted several times. Cases suitable for this operation are those in which the growth is situated in the upper portions of the bladder—a situation in itself of great rarity. If the growth has not penetrated the walls of the bladder, Antal advises stripping back the peritoneum before the bladder-wall has been incised, and resecting all that portion which is infiltrated and then uniting by sutures the edges of the wound thus made. Guyon counsels resection of the growth from the superficial layers, leaving the deep layers of the bladder-wall intact. Sonnenberg resected two-thirds of the bladder-wall, including the peritoneum. The wound in the peritoneum was stitched. The patient lived one month, and then died from exhaustion.

To Pawlik of Prague belongs the credit of having performed a successful operation for the total extirpation of the bladder.[1] The preliminary steps were to fasten the cut-off ends of the ureters into the vagina, and when these had become firmly established the bladder was removed, and the vagina took the place of that organ "in a satisfactory manner." It is interesting as a surgical *tour de force*, but that the small minority of patients who might survive the operation would not prefer death, may well be doubted.

INJURIES AND DISEASES OF THE PROSTATE.

WOUNDS OF THE PROSTATE, from accident, are by reason of the manner in which the gland is protected, of rare occurrence. Occasionally contusion follows violent concussions of the perineum, as from the pommel of a saddle in riding. The gland may be also wounded by the trocar in the perineal and rectal methods, now rarely used, of puncturing the bladder, by the introduction of foreign bodies into the rectum, by splinters of bone from a fractured pelvis, and by clumsy attempts at catheterization. Such wounds are usually inflicted during a surgical operation, such as lithotomy.

Symptoms.—The symptomatology of these injuries should be considered in relation to—1, the danger of urinary infiltration, if the urethra be involved; 2, hemorrhage; 3, infectious phlebitis.

1. Urine extravasating from a wound of the prostate passes down to the perineum and thence into the ischio-rectal spaces; it may also ascend to the pubes from the prevesical space, and thence into the penis and scrotum and infiltrate the thighs. When the wound is confined to the prostate, the infiltration of urine is usually chiefly restricted to the perivesical spaces by the layers of the recto-vesical fascia. The skin

[1] *Wiener med. Wochenschrift*, November 7, 1891.

over the affected areas becomes flabby and œdematous, then red and inflamed, and finally gangrenous and sloughy.

Free incisions to allow the urine to drain out must be made at once over all the infiltrated region.

2. The hemorrhage, in amount, may be at times alarming, the surrounding tissue becomes rapidly infiltrated with blood; and, if the vesical neck be divided, the blood may flow backward into the bladder. When the hemorrhage is profuse, a hard, globular tumor forms above the pubes.

3. Infectious phlebitis causes induration and infiltration of the coats of the veins, and manifests itself by swelling along their course. The veins near the surface stand out like hard cords, and are exceedingly tender to the touch, while the congestion of the vasa vasorum and the fibrogenous or serous transudation completely destroy their elasticity. Constitutional symptoms are soon manifest by chills, fever, rapid pulse, nausea, dry, coated tongue, and sometimes by delirium. When suppuration takes place in the coats of the vein, they rapidly undergo fatty metamorphosis, and may break down and give rise to serious hemorrhage.

Absolute asepsis in the treatment of the wound is of course the best prophylactic against such phlebitis, but when the disease has set in the constitutional symptoms must be treated by gentle catharsis and by the administration of tonics—iron and quinine—and stimulants, and possibly anodynes, when the pain is severe. Locally, lead-water and laudanum should be applied to relieve both the pain and congestion. Ichthyol in ointment of 20 per cent. strength may also be suggested as an excellent local application.

In general, lithotomy-wounds of the prostate heal kindly, and are seldom followed by urinary fistula or by any impediment to micturition. A few cases have been reported in which it is probable that the contraction of the prostatic cicatrix has resulted in an interference with the action of the vesical sphincter and caused a more or less permanent condition of incontinence. If the wound of the prostate be so extensive as to injure the capsular investment, dangerous complications, such as pelvic cellulitis and even peritonitis, are likely to follow.

Lacerated wounds and rupture of the prostate may be caused by forced catheterization undertaken for the relief of urinary retention due to obstruction by an enlarged prostate. Although this forced catheterization has received the sanction of several authorities, it should be unreservedly condemned, as the consequences which follow it are often disastrous.

Treatment.—If there be an external wound without involving the vesical neck, all foreign bodies should be removed and the wound thoroughly cleansed and packed with iodoform gauze, especially if there be very free hemorrhage. A soft catheter should be then introduced into the bladder through the urethra, and left there for a few days in order to prevent any subsequent retention of urine due to inflammatory swelling of the gland. If, however, the vesical sphincter has been divided, with symptoms of hemorrhage into the bladder, and no instrument can be passed through the urethra, a perineal urethrotomy should be performed, and an English gum-catheter *en chemise* should then be introduced into the bladder, permitting the use of a tampon of iodoform gauze to control the hemorrhage.

n the wound has been produced by forced catheterization, an new blood-catheter should be introduced into the bladder and the d drawn off. If the coagula are too hard, they may be broken up injections of tepid water, or, if this fail, they may be partially ested by a pepsin solution. The bladder and urethra should be irri-ed two or three times daily with a boric acid solution, and salol and ic acid should be given by the mouth. If, however, no instrument be introduced into the bladder, a median cystotomy should be per-ned as above mentioned. Occasionally hemorrhage into the bladder nattended with symptoms either of retention or local distress. Under se circumstances, it has been taught that no surgical interference is essary, as the clot eventually becomes disintegrated and carried off by rine without doing any further harm. But the risk of bacterial tion and decomposition of such a clot is great, and it is wiser to ntegrate it by vesical irrigation, and at the same time keep it sterile using antiseptic solutions: 1:200 carbolic in 1:20,000 sublimate will lly suffice. Urinary antiseptics at the same time should be given he mouth.

FOREIGN BODIES IN THE PROSTATE are generally limited to pieces catheters that have broken off during unskilful attempts at instru-ntation. Various bodies have been introduced into the urethra for ic purposes, usually by old men under the influence of sexual aber-on and the excitation which often accompanies the early stage of static hypertrophy. Such bodies, having slipped from the fingers, perhaps been drawn in by a principle of suction, have eventually lged in the prostatic sinus. By inflammation and ulceration they may rk their way into the substance of the gland.

Symptoms.—There is usually considerable irritation, with pain and tenderness, in the perineum, and an incessant desire to urinate. Examination by the rectum will cause pain and the gland will be found swollen. Occasionally fluctuation can be detected if the inflammation has gone on to abscess-formation.

Treatment.—Sometimes these bodies, especially if they are portions of instruments, can be removed through the urethra with the appropriate forceps. As a general rule, it is necessary to explore the prostate through a perineal incision. If there be any suppuration, the abscess-cavity should be curetted and drained through the perineal wound.

ACUTE PROSTATITIS includes two varieties: first, that in which the inflammation is chiefly seated in the follicles; and, secondly, that in which the entire gland is involved, the parenchymatous variety.

Causes.—The causes of these two forms of prostatitis are various. They may be classified as the infectious and the traumatic. Under the first class, fall those cases complicating the acute febrile diseases. Prostatitis has been reported as a sequel of small-pox, scarlet fever, typhus, etc. I have seen one case during convalescence from typhoid fever. It was of the parenchymatous variety, developed into abscess, and necessitated operation. Such cases are, however, very rare. Tubercular prostatitis is a more common variety of the infectious forms, but should be considered in connection with the general subject of uro-genital tuberculosis. Infection by continuity, as, for instance, from extension backward of a

specific urethritis, is very much more common. Infection by contiguity—*i. e.* through layers of cellular and fibrous tissue, as from various rectal diseases, is, on the other hand, rare—more rare than might be inferred from the propinquity of the parts. The firm capsule of the gland doubtless offers a sufficient obstacle to the entrance of germs by this route, while, on the contrary, the urethra is a constant and easy avenue of approach.

Next to the gonorrheal variety, those cases where both infectious and traumatic factors enter are the most common. They follow the use of unclean sounds or catheters, especially if the latter have been unskilfully introduced; the practitioner who uses a dirty instrument will be unskilful in its introduction. These two causes, the infectious and the traumatic, are therefore conjoined in a large proportion of cases.

The purely traumatic causes are chiefly contusions on the perineum. Predisposing conditions which make these causes far more effective in producing inflammation are constipation, excessive coitus, or masturbation, prolonged ungratified sexual excitement, hemorrhoids, etc. After careful investigation I am convinced that bicycling does not predispose to disease of the prostate or otherwise injuriously affect it, especially if a correct attitude be observed. I have seen a few cases where pre-existent prostatic irritation had been aggravated by riding with the weight borne on the perineum—a position both unnecessary and objectionable.

The *acute parenchymatous* variety is more serious than the follicular. The entire gland within the capsule sometimes seems to be invaded by the inflammatory process. Suppuration usually supervenes, and unless the treatment be prompt and decisive on the first appearance of fluctuation it may result in much destruction of the gland-structure and in great danger to life. This form of prostatitis is fortunately rather rare. It is more serious when it occurs in persons of a broken-down constitution. It is occasionally seen in tubercular patients with gonorrhœa or as a complication of the same disease in patients who have had long-standing cystitis or tight urethral stricture, or as a sequel to internal urethrotomy followed by infection of the wound.

Symptoms.—In both the follicular and the parenchymatous varieties the symptoms are in general the same; in the latter, they are more marked and are more frequently followed by abscess, and, moreover, the parenchymatous variety is not so generally associated with gonorrhœa as is the former. In follicular prostatitis a pre-existing gonorrhœal discharge is either diminished in quantity or altered in character; this is soon followed by a sense of weight and uneasiness in the perineum and rectum; urination becomes frequent and painful, with tenesmus proportionate to the involvement of the neck of the bladder; or retention of urine may follow if the swelling be great. On examination *per rectum* the gland is found to be hot, tender, and enlarged. If the gland-follicles suppurate, or if circumscribed abscess follow the fusion of two or more obstructed follicles, fluctuation can sometimes, but not often, be made out by rectal palpation. If pus has formed, there is usually fever with marked constitutional disturbance.

Diagnosis.—The diagnosis of acute prostatitis is ordinarily not difficult. If the patient have a well-developed or a declining case of

specific urethritis, or be exposed to any of the above-mentioned causes and begins to complain of perineal and rectal pain, dysuria, rectal tenesmus, painful defecation, etc., it is probable that a prostatitis has begun. It may be differentiated from a localized inflammation of the vesical neck (which to a certain extent coexists) by the prominence of the vesical symptoms in the latter case and the absence of symptoms connected with the rectum and perineum. Examination *per rectum* is generally conclusive. Cowperitis often closely simulates it, but here, again, the rectal symptoms are absent, and the presence of a deep, tender perineal tumor is almost constant and is diagnostic. The diagnosis between retention of urine from stricture and that from prostatitis must sometimes be made, but the history of the case, the point at which a sound or catheter is arrested, and the information given by the finger in the rectum, which determines whether or not the instrument has reached the gland, will usually be decisive.

Treatment.—In the very beginning of a prostatitis, if the prostate and the patient were previously healthy and the infection not too pronounced, the case may be made short and mild by rest in bed, elevation of the pelvis, the application of a few leeches to the perineum, followed by hot fomentations, hot rectal douches, and the use of opium by suppository. In addition, a mixture containing bromide of sodium, boric acid, and belladonna will often aid in allaying the vesical irritation. The patient should be cautioned against straining during either micturition or defecation. The diet should consist principally of milk. Water should be taken in large quantities. Urethral medication should be stopped for a time. The use of a catheter should be avoided if possible, but if retention should occur, a small Nélaton catheter (14 to 16 French) should be introduced at such intervals as may be necessary to prevent the straining which adds greatly to the intensity of the disease.

If the case should go on to suppuration and fluctuation can be detected by rectal palpation, the abscess should be drained through a perineal incision. Incision through the rectum should be limited to the rare cases where there is a circumscribed abscess pointing on the posterior surface of the gland directly beneath the rectal mucous membrane. In the great majority of cases it is far better to go directly through the median line of the perineum. There is occasionally considerable hemorrhage after this operation, but it can be easily controlled by gauze tampons or by packing about a catheter *en chemise*. All abscess-cavities should be thoroughly broken up by the finger and the wound freely irrigated with either a carbolic or bichloride solution. Urethral fistula occasionally follows, but usually closes spontaneously.

Periprostatitis and Periprostatic Abscess.—Suppurative prostatitis may extend to the cellular spaces between the rectum and the prostatic or the deep perineal spaces, giving rise to periprostatic abscesses, which are usually caused by infection through the lymphatics from the deep urethra or through a phlebitis of the prostatic plexus.

The symptoms of these abscesses (both prostatic and periprostatic) are alike: there may be retention of urine, and there are always swelling and fluctuation in the rectum or perineum, and similar, but even more marked constitutional disturbances. The swelling is, however, usually

more diffuse in periprostatic abscess, and is apt to point in the posterior or anal perineum and to invade the ischio-rectal space, inasmuch as its origin is behind the middle perineal fascia.

Unless these abscesses are promptly treated the **prognosis** is bad, both as to life and as to the damage to the surrounding tissues.

Treatment.—Escape for the pus must be made by early and free incisions through the perineum. Pointing should never be awaited; any delay permits the almost certain occurrence of extensive sloughing of the cellular tissue of the perineum, the probable occurrence of rectal fistula, and the possible loss of life.

CHRONIC PROSTATITIS is commonly a sequel of one of the acute varieties, the gland often remaining slightly engorged and hypersensitive for a considerable time. It is of course a chronic infection, the original trouble having usually been a gonorrhœa, the micro-organisms, either the gonococci or staphylococci, having found their way into the gland through the ducts and follicles. Irritative injections long continued, excessive coitus, masturbation, hemorrhoids, and habitual constipation, by keeping up chronic congestion of this region, may also, but exceptionally, cause a chronic inflammation of the gland.

The most notable **symptoms** are—occasional spasms of the perineal muscles followed by the escape of a colorless or milky fluid; irritation referred to the posterior urethra; frequency of urination; imperfect erections; premature ejaculations and nocturnal pollutions. In patients of a nervous temperament the effect of these symptoms upon the mind is often most unfortunate. Their importance is grossly exaggerated, and they are allowed to overshadow everything in life, so that the mental condition frequently betokens the most urgent need of surgical treatment, as is often the case in varicocele.

The **prognosis** is favorable, although it should be understood by the patient at the outset that cure is difficult and the course of treatment prolonged.

Treatment.—All aggravating conditions, such as stricture, phimosis, contracted meatus, etc., should be overcome. Erotic excitement should be strenuously avoided. Ordinary sexual intercourse need not be forbidden. On the contrary, I am convinced that many cases of chronic prostatitis would be cured by hygiene alone if it included regular and unemotional sexual gratification. Unfortunately, the large majority of these patients, as is also true of varicocele cases, are young, unmarried adults, and, even if the question of morals were set aside, it is not usually possible for them to secure sexual relations that at all meet the requirements. It is easy for the surgeon to suggest that a happy marriage might be the solution of all the difficulty; it is another matter for the patient to act on the suggestion. The diet should be restricted and all liquors interdicted. Constipation should be most carefully avoided; white-wheat gluten suppositories at bedtime and cold-water enemata once daily are often of great service. Hip-baths of a temperature and duration governed by the sensations of the patients are also useful. Counter-irritation to the perineum by iodine or blisters is also very valuable. The use of the cold jet by means of a bidet is of the most marked benefit in many cases. Cauterization of the prostatic urethra is unquestionably useful. Five drops of a solution of nitrate of silver, beginning at 1 per

cent. and increasing to 5 as the case requires, should be deposited in the prostatic urethra by means of a syringe with a long nozzle curved near the end. This may be repeated at intervals of three days with the weak solutions, and once in five to eight days with the stronger solutions. There is generally an increase in the discharge during the first twenty-four hours after this treatment, but this is usually only temporary. If inflammatory reaction follow to a marked degree, it must be controlled by rest and appropriate remedies.

PROSTATIC GOUT.—As Mr. Reginald Harrison has pointed out, there are certain affections of the region about the neck of the bladder that can be considered as really belonging to "prostatic irritation," and of these the most common is found in gouty patients, where the irritation is so intense as to amount almost to an inflammation. Many cases that are described as neuralgia of the prostate are simply illustrations of this affection.

Symptoms.—Like gout affecting the great toe, the paroxysm comes on usually at night. It is referred to the neck of the bladder. Urination is irresistible, although painful, and spasmodic sympathetic pain often attacks one or both testicles. The patient is sensitive to rectal examination. The urine is highly acid, deposits urates, and contains an excess of mucus. During the day the symptoms are generally in abeyance, but they recur at night with unabated force.

After such a paroxysm the prostate is unusually sensitive for a considerable time. As a consequence, the patient dreads to exercise pressure upon the gland by completely emptying his bladder. Retention of urine under these circumstances is not only a fruitful cause of cystitis, but also predisposes to vesical calculus.

The diagnosis of prostatic gout can be made easily by the exclusion of inflammatory lesions and by the history of gout. It usually merges into a chronic form of irritation unless actively treated.

In the **treatment** of this form of "irritable prostate," both in the acute and in the chronic variety, reliance must be placed chiefly upon the correction of the state of the urine and the use of remedies which usually relieve the manifestations of gout. Patients who habitually suffer from this trouble are often greatly benefited by periodical visits to saline springs.[1]

PROSTATORRHŒA.—This affection is characterized by the discharge of a grayish-white or colorless mucoid fluid, passed after urination and during the prostate's spasmodic contractions in expelling the last drops of urine from the urethra. The fluid may also escape, owing to the pressure of fæces against the gland or to the straining efforts to expel the contents of the rectum. The quantity which is passed at these times varies from ten or twelve drops to a fluidrachm.

Causes.—The chief causes of prostatorrhœa are gonorrhœa, masturbation, and prolonged ungratified sexual desire. The symptoms scarcely warrant the assumption that any inflammatory element is present, but rather point to a supersensitive state of the gland favoring congestion. Among other causes found at times are—acute congestions dependent upon cold; traumatisms by the passage of an aseptic instrument; the ingestion of certain irritating substances, like turpentine or cantha-

[1] Harrison: *International Encyclopædia of Surgery*, vol. vi.

rides; or a diathesis, such as rheumatism, which renders the urine irritating.

Symptoms.—The effect of this discharge is peculiarly depressing to the mind of the patient, who imagines he is losing his semen, with consequent total loss of sexual power. It is not at all uncommon to meet with cases where the mind has become so thoroughly occupied with anticipations of evil that the patient has been rendered incapable of attending to business or of enjoying the pleasures of society.

Diagnosis.—The only affections with which prostatorrhœa can be confounded are gleet and spermatorrhœa. In gleet the discharge is purulent or muco-purulent, and must have been preceded by gonorrhœa, while in prostatorrhœa the discharge is clear and free from pus. Between prostatorrhœa and spermatorrhœa the differentiation can be easily made with the microscope, as in the former only a few spermatozoa are found, while in the latter they are superabundant.

Prognosis.—The prognosis, as a rule, is good. In deciding upon the prospects in any given case the question arises, Into which of the three following classes it is to be assigned?—1. Those suffering from the sequel of gonorrhœa; 2. Those who have been subjected to prolonged ungratified sexual desire; 3. Those who have indulged in inordinate masturbation.

Patients belonging to the first two classes, provided that they can spare the time necessary for treatment, are usually cured. Patients of the third class, although usually younger in years, do not often yield to treatment. This is probably because the habit has such a hold upon them that they cannot overcome it, and because they are usually of a weak constitution with slight recuperative power. For those who have brooded over their trouble so long that they have become what are known at the clinics as "sexual cranks" the prognosis is most unfavorable. The condition and its cause, in these cases of neurosis, work in a vicious circle: the more the sufferer occupies his mind with his symptoms, the worse his symptoms grow, and with the aggravation of his symptoms comes more worry for the mind. This class is composed chiefly of those who follow an in-door, sedentary occupation, and who cannot afford to lose a day's work for change of scene and diversion of mind from its turbid channel. They are also often afflicted with that dangerous smattering of medical knowledge acquired by frequent visits to free dispensaries and also by the advertisements of quack medicines, and until the whole trend of their thoughts can be altered (which is of unquestionable importance and practically a cure) there is small chance for them.

Treatment.—Since the underlying lesion is a catarrh of the prostatic urethra, the treatment of prime importance is directed to the relief of the catarrh. In many cases the disease may be cured under general hygienic rules and by food and medicine calculated to correct an abnormal condition of the urine.

The bowels must be opened regularly with cascara, magnesia, or Hunyadi; bathing must be regulated, and when the patients are vigorous and cold water not disagreeable, a shower or plunge in the morning may be recommended. If the patient be feeble, a hot plunge-bath is advisable. A certain amount of regular exercise must be prescribed, and usually all stimulants should be interdicted; the feet must be protected from

dampness, as chilling of the surface exerts a particularly bad effect upon inflammation about the neck of the bladder.

The *medicinal* treatment, although of minor importance and not germane to the subject of this article, should not be neglected. Among the most useful drugs which our space permits us to mention are those which in their elimination stimulate the prostatic mucous membrane. The oil of sandal-wood in ten-minim capsules, three times daily after meals, is perhaps the best remedy of this class; belladonna is serviceable when there is any irritation of the bladder. Gross considered atropia the best internal remedy that could be given. At night, if the patient suffer from lascivious dreams or nocturnal emissions, a full dose of bromide should be given just before going to bed.

On the *local* treatment the main dependence must be placed. Soluble prostatic bougies of zinc and hydrastis have been recommended, but have not proved altogether satisfactory. Occasionally prostatic dilatation may be of service; it seems to act beneficially by mechanically emptying the diseased follicles of their contents, thus allowing the instillation, which should always follow, to gain access to every part of the mucous membrane. These instillations are composed of nitrate of silver in varying strengths, beginning at 1 per cent. and gradually increasing to 5, watching the result. From ten to fifteen drops should be deposited in the prostatic urethra by means of a long curved syringe. The instrument should be lubricated with glycerin or boroglyceride; all other substances decompose the silver or at least form a film through which the silver cannot act.

This treatment should be repeated not oftener than once in one or two weeks, and the effect carefully watched. The dilatation should not be less than No. 36 nor more than No. 44 French scale. Irrigation with carbolic solution, 1 : 500 or stronger, often seems useful, rather, I imagine, by virtue of its anæsthetic than its antiseptic properties. If used as hot as can be comfortably borne, it sometimes does more good than at lower temperatures. On the other hand, cold enemata and cold douches to the perineum by means of the bidet have seemed to me of more value the longer I have observed their effect. I called attention in 1888 to the use of the bidet in these cases, but the suggestion has not been widely adopted.

Blisters to the perineum are often of great value. In obstinate cases, due to a neurosis, electricity often may be of service, and the galvanic current may be used by means of an urethral electrode, with one pole applied to the lumbar spine and the other to the prostatic urethra. If the treatment be rigidly enforced, recovery will take place, in the majority of cases, in from one to four months.

Where local treatment seems to aggravate the disease, it is advisable to change the patient's entire mode of living; prolonged vacation and travel will often effect a cure when the disease has obstinately resisted local treatment.

ENLARGEMENT OF THE PROSTATE.—Enlargement, or, as it is more commonly known, hypertrophy, of the prostate consists of an overproduction of the normal cellular constituents taking place in either of the lobes or in the posterior median portion, or it may and commonly does affect the entire organ. It may be uniform, while at the same time

an irregular shape may be given to the organ by numerous small tumors either imbedded in the tissue or possibly almost completely separated from the main body of the gland, but enclosed within the capsule. Following Thompson's classification,[1] which is as good as any, the different forms of enlargement may be arranged as follows: (*a*) Over-development of glandular and stromal tissues in nearly their normal proportion, a true hypertrophy. The organ is evenly, but not greatly, enlarged, and seldom causes symptoms of importance. (*b*) Increase of the stromal tissue, chiefly the white fibres, and not the muscular elements. It is the form of enlargement most commonly met with, and may attain a large size. Guyon[2] considers this form a sclerosis identical with that process in in other organs; whereas Thompson thinks that it should be classed rather as a fibrous hyperplasia, since it does not tend to contraction as sclerosis does in all other organs, nor is it associated with impaired blood-supply, nor is it a process of degeneration in pre-existing structures. (*c*) In a third class the overgrowth of glandular tissue predominates over the stromal; this is rarely found to be permanent; Thompson has observed but two such cases. In one instance the gland weighed over three times the normal. Usually the glandular tissue finally disappears and is replaced by a fibrous growth of greater density. (*d*) Simple tumor-formation, a local hypertrophy, very commonly observed. These small tumors are found in almost every case of hypertrophy of the prostate, and seem to be confined to no one particular portion. According to Moullin,[3] they are merely areas of marked local hypertrophy, enlarging more rapidly than the surrounding tissues. The enlargement is always confined within the capsule of the gland, although some portions, enlarging more than another (*e. g.* the small tumors just mentioned), may extend to a considerable distance from the gland, pushing the capsule ahead of them, and connected with the gland only by a thin band of glandular and fibrous tissue. Hypertrophy always takes place toward the base of the prostate, and consequently the neck of the bladder is pushed upward and the normal curve of the urethra destroyed. The earliest sign of enlargement is the increased thickness of the gland and its tendency to become globular; the groove which normally separates the two lobes becomes obliterated. The form may then become very uneven from enlargement of one of the lateral lobes, or the posterior median portion, the so-called "middle lobe."

From the increased thickness of the gland the prostatic urethra is lengthened, and at the same time becomes somewhat tortuous if the hypertrophy is unevenly distributed. I have observed it lengthened by as much as three and a half inches. If only one lateral lobe is enlarged, the urethra is twisted to the opposite side; if both lateral lobes are enlarged, it is narrowed and flattened; and if the median portion alone is involved, the channel of the urethra assumes somewhat the shape of the letter Y, and the vesico-urethral orifice becomes of an inverted crescent shape. The hypertrophied portion is tense and hard. Any portion may be affected singly, but more commonly, as has been said, the whole gland is affected. Thus, Thompson[4] found that out of 123 specimens of enlarged prostate, in 74, or more than half the number, the whole gland

[1] *Diseases of the Prostate*, p. 66. [2] *Annales des Mal. d. Org. gén.-urin.*, Mar., 1885.
[3] *Enlargement of the Prostate*, p. 21. [4] *Op. cit.*, p. 55.

was affected; 19 where the median portion was more hypertrophied than the rest of the gland; hypertrophy of the right lobe predominated in 8, of the left lobe in 11. As rarer forms, he found in 5 specimens the lateral lobes alone enlarged; the anterior commissure only, or chiefly, enlarged in 3; and, again, in 3 the lateral lobes and anterior commissure, but not the median portion. These observations coincide in the main with similar investigations conducted by Messer.[1] Watson found the chief obstruction to urination to be median enlargement in nearly 90 per cent. of the cases he collected. Viguard's figures show a lesser degree of median overgrowth.

The enlargement of both lateral lobes produces a marked diminution in the shape and calibre of the prostatic portion of the urethra by both lengthening it and at the same time narrowing it until it becomes hardly more than a slit. If there is also enlargement of the median portion, the flow of urine is almost completely obstructed, and from the uplifting of the neck of the bladder a pouch is formed above, and in front, under the pubis, and also posterior to the prostate and below it, in the bas-fond of the bladder.

The interureteral bar of muscular fibres frequently met with in cases of enlarged prostate is the outcome of efforts to expel urine from a part where it is apt to accumulate and cause irritation. Occasionally, cases are seen where an unusually depressed state of the trigone appears to have existed previous to the prostatic enlargement; in fact, a condition of residual urine was antecedent, and not subsequent, to the enlargement. The trigone, in addition to being a highly sensitive part, is peculiar in the fact that it contains few muscular fibres; therefore, if from any cause, such as weakness associated with advancing age, the non-contracting part of the bladder, the trigone, becomes depressed, the patient will be unable to get rid of the last drops of urine.

The average weight of the normal prostate being about four and a half to five drachms, any prostate weighing over six and a half drachms may be considered abnormal. In Thompson's and Messer's tables no healthy prostate weighed over six drachms; some weighed just six, and were found to be healthy; but then, again, many weighed under six, and yet showed signs of hypertrophy in the shape of small tumors. The commonest weight of an hypertrophied prostate, according to Thompson, ranges from seven drachms to ten drachms.

The enlargement can be estimated clinically only by the length of the urethra and by a rectal examination of the prostate itself. Moullin asserts that an increase of .5 cm. ($\frac{3}{16}$ of an inch) in the length of the prostatic urethra indicates an enlargement. "The length of the prostatic urethra is," he says,[2] "about 3 cm.; if it measures 3.5 cm. there is an enlargement." With Moullin's arithmetic, at least, no one can cavil.

While it is the rule that hypertrophy of the prostate occurs chiefly in men who have passed the age of fifty-five, there are many exceptions in which the gland enlarges and gives rise to symptoms of obstruction at a much earlier age: I have seen enlarged prostates at the ages of forty-two and forty-four. In a case operated on by McGill,[3] the patient was fifty-three, the age at which Thompson says[4] he has never

[1] *Trans. Med.-Chir. Soc.*, xliii. p. 153.
[2] *Enlargement of the Prostate*, p. 22, 1894.
[3] *Brit. Med. Journ.*, Oct. 19, 1889.
[4] *Op. cit.*, p. 93.

seen enlargement; Mudd reports a case of an enormous overgrowth of the prostate not due to malignant disease as shown by the microscope, but a genuine hypertrophy where the patient, a negro, was only twenty-seven.[1] The disease, therefore, cannot be said to be invariably a disease of old age, nor can it be held to be its invariable accompaniment; many an aged man never so much as knows that he has a prostate. Examination of 164 individuals between the ages of sixty and ninety-four gives the following results: In 97 the prostate was unaffected; in 56, or about 34 per cent., it was enlarged; in 11 it was atrophic. The mean age where enlargement occurs was 75.03; in nearly 50 per cent. the condition caused no symptoms.[2] Enlargement, therefore, only exceptionally begins before the age of fifty or after seventy. The time of life at which it first makes its appearance must not be confounded with the age at which the presence of residual urine is first diagnosed, as the growth may have been there for years before giving rise to this particular result. "Sir George Humphrey states that of 72 persons between eighty and ninety years of age, only 17, and of 30 above ninety only 1, suffered from urinary troubles referable to enlargement of the prostate."[3] An examination of Messer's tables, founded on a dissection of 100 prostates in men over sixty years of age,[4] discloses one interesting fact in this connection. Assuming, arbitrarily, that eighty may be taken as the age at which, in the great majority of men, the sexual life is absolutely and finally ended, we find that among those subjects whose prostates weighed over six drachms the percentage of octogenarians or their elders was only 22.8, while among those whose prostates weighed less than six drachms (many of them less than normal) the percentage was 35.3, more than half again as great. This is not only confirmatory of Denos' observation[5] that after a certain period in life the frequency of notable hypertrophy diminishes, but it suggests the possibility that in many of these cases physiological atrophy had already begun. The subjects were not selected from among patients, but just as they happened to come within reach of the investigator.[6]

Etiology.—The cause of enlargement in advancing years is unknown. I have suggested the following solution of the problem, merely as a possible working hypothesis: The function of the testis, like that of the ovary, is twofold—the reproduction of the species and the development and preservation of the secondary sexual characteristics of the individual. The need for the exercise of the latter function ceases when full adult life is reached, but it is possible that the activity of the testis and the ovary in this respect does not disappear coincidently, and that hypertrophies in closely-allied organs like the prostate and uterus are the result of this misdirected energy. This hypothesis would increase the analogy between the fibromyomata of the uterus and the adenofibromata of the prostate, which, from a clinical standpoint, is already very striking, and is further strengthened by the almost identical results of castration in the two conditions.

[1] *Trans. of the Ass'n of Genito-urinary Surgeons*, June, 1890.
[2] Thompson, *Enlargement of the Prostate*, p. 93.
[3] Moullin, *op. cit.*, p. 156.
[4] *Med.-Chir. Trans.*, vol. xliii. p. 147.
[5] *Dict. des. Sciences méd.*, 2d series, tom. xxvii. p. 506.
[6] White, *Annals of Surgery*, 1893.

Guyon's assertion [1] that the enlargement is dependent upon general atheroma is difficult to understand. It is undoubtedly true that these two ailments are often associated, and that they are common to the same period of life. Guyon also claims that the obstruction is due not to the prostate, but to the simultaneous weakening of the vesical contractility resulting from degeneration of the bladder-muscles. It is not uncommon to meet with men of advanced age with enormous overgrowth of the prostate who have never experienced the least inconvenience during urination, whose arteries although tortuous are not otherwise diseased, and whose kidneys are perfectly sound. The prostatic enlargement cannot be thus accounted for; it is impossible that general atheroma, which is always associated with defective nutrition, can aid in the formation of a prostatic mass that frequently fills the bladder.

There is still another variety of enlargement where the prostate becomes excessively hard, showing but little alteration in shape, and, although only slightly above the normal size, may give rise to very marked obstruction. It might seem that such a condition as this may have possibly for its cause a general sclerosis.

Symptoms.—For some time before the patient has an idea that there is anything wrong with his urinary organs he probably notices a lack of force in the stream; the urine falls straight down, instead of being propelled from him; there is also incomplete stoppage of the flow and the last few drops dribble away slowly. At first this symptom causes but little inconvenience, and is ascribed to the natural weakness of advancing years. As the enlargement increases, however, the lack of propulsive power amounts to an obstruction, and urination is accompanied by painful straining, which nevertheless does not avail, but may even add to the symptom by causing a sudden total stoppage of the stream.

Increased frequency of urination is another early symptom of enlargement. At first it is caused by the congestion of the bladder-walls round the urethral outlet and also by the congestion of the prostatic urethra, due to a urethrocystitis or prostatocystitis; but after the bladder has become pouched, and residual urine reduces its capacity, this undue frequency of urination is really caused by the over-distention of the bladder, albeit the patient receives the impression that at each act the bladder is emptied.

Nocturnal frequency of urination soon becomes a distressing symptom, and, when a patient in a night is compelled to urinate as many as nine or ten times, a very grave one. The cause of this has been ascribed to the more irritating nature of the urine secreted at night than during the day; in part, this may be true, but it may be doubted if urination be really more frequent during the night than during the day. All disturbances at night make on the patient's mind a much deeper impression than those by day, and anxiety really exaggerates two or three disturbances into a constant series. It must be borne in mind that where a patient micturates habitually once during the night it is significant, and the gravity of this significance increases with the frequency of the act.

During sleep the healthy sphincter of the bladder remains in a state of tonic contraction. But when there is enlargement of the prostate

[1] *Ann. des Mal. des Organ. gén.-urin.*, Mar., 1885.

this sphincter, by its changed relation to the bladder, becomes weakened; besides, the urethral orifice not infrequently becomes somewhat expanded within the bladder, and allows a few drops of urine to ooze into the sensitive prostatic urethra, and during sleep, when the voluntary or involuntary control of the sphincter is additionally relaxed, these few drops of urine are sufficient to stimulate urination. Hence it may be possible to explain this apparently greater frequency of urination by night on the supposition that it is due not to any nocturnal change in the quality or quantity of the urine, but to a relaxation, from the causes mentioned, of the sphincter vesicæ. That it is not due to the position of the patient is shown by the fact that urination is not more frequent during the daytime when the patient remains in a recumbent position.

As the enlargement advances there comes a difficulty in starting the stream; the bladder-walls become weakened by constant straining, and although the desire to micturate is urgent (a desire caused, possibly, by the reflex started by a single drop of urine making its way to the prostatic urethra), the bladder-walls have not the strength to overcome the obstruction. The delay may also be due to a temporary reflex inhibition of the detrusor muscles.

Residual urine, remaining after the patient has apparently emptied his bladder, depends considerably upon the form of enlargement; it is more or less present in every case, but it is a more marked and earlier symptom when the median portion of the prostate predominates in the hypertrophy and where it projects backward into the bladder. Owing to the altered relation induced by the overgrowth at the neck of the bladder, a pouch is formed below the urethral outlet, and in this a certain amount of urine is constantly retained which the exhausted and thin walls of the bladder are unable to expel. This pouch continually increases in size, owing to the relaxed state of the vesical walls, and finally the amount of residual urine increases until the bladder becomes constantly distended and the condition of retention with overflow, sometimes mistaken for incontinence, ensues. Before this constant overflow takes place the amount of residual urine may cause merely very frequent urination. Small amounts of residual urine cause no inconvenience unless the urine decomposes and a cystitis is started.

Complete retention of urine may be an exceedingly early symptom of hypertrophy, although it usually occurs only late in the disease. It may be brought on, in the first stages, from exposure to cold, over-distention of the bladder, excesses of all sorts, etc., which tend to increase the blood-supply of the pelvic organs. It arises chiefly from congestion and swelling at the neck of the bladder. In the later stages, it is due to the blocking of the urethral outlet by the enlarged lobes of the prostate; it is, however, but seldom complete, and is gradual in its onset.

Pain is very rarely felt in the prostate in simple hypertrophy, but is occasionally referred to the thighs and testicles. There is, usually, in cases of marked hypertrophy, especially where the growth extends posteriorly, a feeling of distention and weight in the perineum and in the rectum. Sometimes this feeling of distention in the rectum causes painful rectal tenesmus, and from this tenesmus, both at stool and during urination, the bowel may become prolapsed or painful hemorrhoids be

formed. As soon as severe congestion or cystitis sets in, the pain centres chiefly round the bladder, and each act of urination becomes agonizing in the extreme; the pain then may be referred principally to the end of the penis. True incontinence of urine is found in hypertrophy of the prostate only in very rare cases; I have never seen one. A cause for the production of true incontinence suggested by Mercier[1] is that when the prostate is uniformly enlarged the median portion acts as a wedge and separates the lateral lobes, so that the urethral orifice is kept constantly open. He gives particulars of four cases in support of this possibility.[2] Thompson justly discards this view as improbable; the tendency of the median portion is to enlarge backward or upward into the bladder; it never appears to grow forward or to act as a wedge.

Until the bladder becomes so far weakened and congested that a superabundance of mucus is constantly retained, and the urine becomes alkaline and decomposed from septic infection, there is but little alteration in the chemical quality of the urine. The quantity, however, is usually much increased and the secretion is of low specific gravity. The increase is due partly to old age, and partly to the general fibroid changes which take place in the kidneys from the constant passive hyperæmia brought about by the reflex irritation from the neck of the bladder. Tube-casts are seldom present except when produced by infectious inflammation in the course of cystitis. When this latter disease has once set in, the urine becomes intensely foul, loaded with pus, and possibly with blood.

Diagnosis.—The age of the patient and difficult urination generally make the diagnosis clear at once. There are other diseases, however, which must be eliminated from the diagnosis before enlargement of the prostate can be affirmed from the history of the case.

Stricture of the urethra may cause both the increased frequency and difficulty of urination and also a small amount of residual urine. In this case, however, the patient usually does not suffer so much from nocturnal frequency of urination, and, furthermore, increased effort will usually aid, and not retard, the stream as it does in prostatic hypertrophy. In addition to this, an examination of the urethra with bulbous bougies reveals a constriction at a depth of not more than six inches from the meatus. Malignant disease and tuberculosis are always accompanied by much more pain than simple hypertrophy, and are almost always characterized by profuse hemorrhage.

Rectal examination is one of the surest and best means of determining the size, shape, and consistency of the prostate, and when, in addition, a sound is introduced in the urethra, a very accurate estimation of the size of the prostate is possible. By introducing an instrument into the bladder through the urethra the thickness of the gland between the rectum and the bladder may be felt, and also the length of the gland as it extends up into the vesical cavity may be ascertained. Furthermore, by the aid of a short-beaked vesical sound an estimate may be gained of the thickness or other deformity of the edges of the urethral opening, as well as of the turnings and of the diversion of the prostatic urethra. The patency of the urethra and the encroachments upon its calibre by pros-

[1] Quoted by Thompson, *op. cit.*, p. 106.

[2] *Récherches anat., path. et ther. sur les Mal. des Org. gén.-urin.*, Paris, 1841.

tatic outgrowths are best ascertained by introducing solid steel instruments, or silver, or soft English catheters. If these instruments are arrested at a point more than seven inches from the meatus, the obstruction is in the prostatic urethra. If an instrument with a prostatic curve be arrested at the same point, but on continued pressure passes on into the bladder, often with a distinct jump, and if a Mercier "elbowed" catheter goes in without difficulty, the obstruction is probably one caused by upward projection of the urethral floor, and its distance from the meatus can be measured by the solid sounds. If the moderately stiff Mercier catheter will not pass, but a very small gum catheter or one of the rat-tail pattern enters, the urethra is probably deflected to one side or the other. If all instruments enter readily, but the outward flow of urine is decidedly interfered with, the obstruction is valvular.

The cystoscope sometimes shows plainly the intravesical projections of the enlarged prostate, and the urethroscope may demonstrate the seat and the anterior surface of an intra-urethral obstruction.

The tone of the bladder is measured by estimating the force with which the urine is propelled through the catheter. The condition of the ureters and pelves of the kidneys exceptionally may be shown by cystoscopic examination. In these cases this is often impossible, but when practicable, the openings of the ureters and the periodicity and vigor with which they eject the urine can be seen; at times it may even be possible to pass an instrument into the ureters by means of the catheterizing urethroscope, and, by an examination of the urine drawn, determine how much damage has been done to the kidney and its pelvis.

Instrumental examination will also determine the severity of the urethro-vesical inflammation and the amount of muscular spasm of the sphincters.

Residual urine is detected by passing a soft catheter just after the patient has emptied his bladder as completely as possible. It is, however, unwise to draw off more than a few ounces at a time; syncope not uncommonly results if great distention is suddenly and completely relieved.

The clinical classification of cases of hypertrophy of the prostate may be made from various standpoints. The following factors are, however, most worthy of mention as having a direct bearing upon treatment. They should be taken into account in deciding upon the management of any particular case:

(1) The predominant character of the growth, whether soft, indicating excess of glandular and muscular elements, or hard, showing advanced fibroid change. The distinction can be made more simply and accurately by rectal palpation than by any other method.

(2) From a practical standpoint the seat of the growth is of chief interest in relation to the changes in the bladder. In a general way it may be said that when the enlargement affects chiefly the lateral lobes, the urethra is narrowed and compressed, and the condition is analogous to that existing in organic urethral stricture. The difficulty in urination depends on causes purely obstructive and quite outside of the bladder itself. That organ undergoes, therefore, the usual hypertrophy and thickening of its muscular walls, with diminution of the size of its cavity. There is little or no residual urine.

If, however, the growth is median and projects backward into, and beneath, the neck of the bladder, or if the lateral lobes are elongated in the same direction, a dam is formed, behind which urine accumulates. The muscular tissue at the base of the bladder, unable to contract properly, atrophies and thins; the post-prostatic pouch forms and increases. Generally, vesical atony supervenes, and often the expulsive power is completely lost, so that in neglected cases the only urine which escapes from the bladder is the overflow.

These two conditions may be best differentiated during catheterization. In the former, when there is uncomplicated lateral enlargement and vesical hypertrophy, the catheter goes in, possibly with difficulty, but without the necessity for great depression of the handle; it does not go to an unusual depth before reaching urine; there is little or no residual urine. In the other variety the presence of the median obstruction is recognized by the difficulty, often the impossibility, of passing an ordinary instrument, and the necessity for employing one of larger curve or with longer shaft, or of using a Mercier or other catheter coudé. There is always some residual urine—often many ounces.

(3) A third and not unimportant classification may be made on the basis of the presence or absence of general sclerosis. If this condition be a factor in the case, rigid vessels, arcus senilis, polyuria, hyaline casts, etc. will be associated with the evidence of vesical inability due to rigidity of the bladder-walls. The prostatic enlargement will usually be dense and distinctly fibroid.

(4) Infection of the vesical mucosa with pyogenic organisms should be mentioned as modifying materially any grouping of prostatic cases. Indeed, it is almost of itself a sufficient basis for classification, and, if we were compelled to rely upon one single factor, it might be said with some justice to take precedence of all others.

While the above classification cannot be regarded as exhaustive, and while it must be admitted that, as to each of the first three groups, cases will be found which it will be difficult to place, it is believed that, on the whole, it will prove a distinct help in questions of treatment.

The treatment of hypertrophy of the prostate may be considered as—(1) medicinal, (2) palliative, and (3) operative.

(1) Of the drugs which may be employed with any hope of benefit in cases of hypertrophy but little can be said; no drug seems to have a specific influence on the prostate unless it be ergot, which is administered on the plausible theory that the prostate being possibly the analogue of the uterus, as has been before remarked, it will respond in a similar manner to similar influences. It will be frequently found to be beneficial where hypertrophy of the muscular elements seems, from the softness of the gland, to predominate; it, however, should not be relied upon alone, but should be merely auxiliary to other treatment—instrumentation, etc. Certain other drugs, such as salol, diuretin, boric acid in conjunction with belladonna and the bromides, will often be of great service in the prevention and treatment of the complications of prostatic hypertrophy, notably cystitis.

(2) Palliative treatment consists of dilatation of the prostatic urethra with steel sounds or other dilating instruments, and of the use of the catheter. Dilatation will be beneficial chiefly in those cases of incipient

hypertrophy where urination is not distressingly frequent and the amount of residual urine is small, and where the enlargement, as felt through the rectum, is of moderate density and offers but slight resistance to the introduction of an ordinary catheter. That this treatment modifies the early symptoms, lessens the vesical irritability, and diminishes the amount of residual urine is beyond a doubt, but that it can have any positive curative action or really control the continuous enlargement of the gland is unlikely. To be of any benefit the largest-sized steel sound which will pass the membranous urethra should be passed into the bladder and allowed to remain there for ten or fifteen minutes every fifth day. Rigid asepsis is of course necessary.

In cases where the residual urine amounts to three or four ounces and is sterile, and where also an instrument can be passed easily and painlessly, catheterization should be systematically performed. In general, if the urine be sterile as aforesaid, and about three ounces remain in the bladder, catheterization should be performed once daily; where six ounces remain, catheterize twice daily, and once more for every additional two ounces. The withdrawal of the residual urine is not unattended with risk, not only remotely from the production of cystitis, but directly from the production of immediate syncope or subsequent development of "catheter fever," which may come on with a chill several hours after operation, and be accompanied by profound prostration, a rapid weak pulse, shallow respiration, and rising temperature, the fever sometimes mounting up to 106° F., and usually subsiding by crisis on the outbreak of a profuse sweat. The exact etiology of "catheter fever" is unknown; the rigors are possibly due to the irritation of the nerve-fibres distributed throughout the urethra, but more probably there is some slight and often unavoidable traumatism which permits the absorption of pyogenic material (fibrin-ferment, ptomaïnes, etc.) in minute quantity. The chill usually follows the next act of urination after the passage of the instrument, but, if the kidneys be healthy, is not of much significance.

Guyon and Michon[1] have reported 56 cases of prostatic hypertrophy in which the associated cystitis, due to infection, was treated by the use of a retained catheter. Five of these cases had malignant disease of the prostate; the remaining 51 had simply hypertrophy with retention; 49 of them, at the time the treatment was begun, were undergoing an acute exacerbation of a chronic cystitis, and had the usual symptoms with the associated fever. In 38 of these cases (77 per cent.) a cure was obtained and no intercurrent complications occurred. In the other 11 (22 per cent.) the symptoms persisted. In the favorable cases defervescence was noted at a time varying from the first to the sixth day, oftenest on the third day. In 6 cases (of the 56) cystostomy was performed on account of persistent fever. Four of these died, 2 were cured. Lagoutte[2] reports as a result from suprapubic cystotomy in infected prostatics a mortality of 35 per cent.

In 4 of Guyon's prostatic cases marked hæmaturia consecutive on instrumentation was taken as an indication for the retained catheter, and in another case hæmaturia from a vesical neoplasm was the indication.

[1] *Ann. des Mal. des Org. gén.-urin.*, May, 1895.

[2] *Des Résultats eloignés de la Cystostomie sus-pubienne*, Lyon, 1894.

In all of them the hemorrhage did not recur after three or four days, and in all but 1 the accompanying fever disappeared. In addition, 5 cases of retention of urine, and 7 of false passages, were treated in the same manner, and with equally good results. Minute directions are given for fixing the catheter in the proper position, so that the urine will run from it continuously, drop by drop, the rule being that continued pain and persistent fever mean that the sound is too far within the bladder. Equally detailed instructions for tying it in place are added. The article is convincing of the value of this treatment as a palliative, possibly as a temporary cure, of the infective cystitis. The principle is obviously that of drainage.

It may be said at once that in those patients with but moderate obstruction or with a high grade of compensatory hypertrophy of the bladder, with a small amount of residual urine, which remains sterile, and in whom catheterization is easy and painless, operation is not to be thought of. The time may come when by perfecting our methods of diagnosis and our operative technique this class of prostatics may be benefited by active surgical interference, but it has not yet arrived. Dilatation and catheterization, as above described, at present represent the best therapeutics, especially if the rigid observance of details of antisepsis be emphasized. But it must be remembered that these methods are, in the majority of cases, merely palliative, and that, as a rule, the introduction of instruments gradually becomes more difficult; cystitis and atony of the bladder result from the catheterization, which increases both in frequency and in painfulness, and some operative measure must be considered.

Operation is therefore indicated when the patient is unable to pass a catheter upon himself, or when instrumentation becomes more and more difficult and painful, or when the urine begins to show fermentative changes and cystitis seems inevitable. Unfortunately, however, the majority of patients have passed this most favorable period for operation before they come under the hands of the surgeon, and the pronounced vesical and renal infection, and perchance the general septicæmia and chronic uræmia which exist, obscure the true value of the surgery of the prostate and limit the chances of success. All cases, however, except those complicated by advanced infective renal disease, should be given the opportunity of relief afforded by operation. The only operations for the relief of obstruction to the urine from prostatic enlargement which need be considered are—1, over-stretching the prostatic urethra; 2, prostatotomy through the urethra; 3, perineal prostatotomy; 4, prostatectomy, (*a*) through a perineal incision, (*b*) suprapubic prostatectomy; 5, castration to promote atrophy of the gland.

1. Over-stretching of the prostatic urethra will not prove of much benefit where the trouble lies chiefly in the median lobes and the vesical neck. In cases of lateral hypertrophy, where the urethra is simply narrowed or is narrowed and rendered tortuous, it might be of use. If it is tried, it should certainly be conducted under ether, and should be carried to the farthest degree consistent with safety. I have often thought of following the suggestion made by Physick, early in the century, as to the use of what he called "hydraulic compression," for which he invented a special instrument, or of repeating Sir Henry Thompson's

experiments with a hydrostatic dilator which were made nearly forty years ago, but I have never done so.

Thompson dismissed the whole subject in his later publications with the remark that no one with experience now ventures to use instruments sufficiently large to produce any diminution of the gland, or any dilatation of the canal which passes through it, by the agency of compression, on account of the probability of exciting prostato-cystitis. He rejects, too, the idea that by this agency any beneficial effect on the gland is possible. It must be remembered, however, that this opinion dates back to the time when antisepsis in genito-urinary surgery was unknown. Undoubtedly, this mode of compression, with the slight bruising of the gland and the minute laceration of the mucous membrane produced by it, favored the development of an infective inflammation, and this was probably the cause of the "aggravated suffering" which Thompson describes as following dilatation. The possibility of exciting a traumatic prostato-cystitis is not denied, but the risk is one which may be well assumed by both patient and surgeon if the method lessen the obstruction which is the chief cause of all the gravest symptoms. The atrophy of the prostate following stricture of the urethra is well known, and is asserted by Thompson himself to be due to pressure. This subject has been thus brought forward because my experience with the simpler dilatation by means of ordinary sounds seems to justify the hope of greater good from more thorough treatment on the same lines. It is, however, included among operative instead of palliative measures; it is a more formal procedure and aims at farther-reaching and more permanent results.

The operation may be said to be indicated (tentatively or experimentally) in those cases where palliative treatment has failed and more radical measures are declined.

2. Prostatotomy, or division of the bar at the neck of the bladder reached through the urethra, need be named but to be condemned. It is working too much in the dark, and therefore involves great risk of uncontrollable hemorrhage. Furthermore, where it has been attempted the relief was found to be very temporary. For a similar reason Bottini's galvano-caustic treatment[1] should be discarded, except in cases where, for one reason or another, all other operations are inadvisable, and where there is marked irritability of the bladder from congestion of the mucous membrane at the neck. In such extremely rare cases it might be employed through a perineal incision, but through the urethra I do not deem it justifiable.

3. Perineal prostatotomy, performed through an incision as for Cock's operation for the extraction of calculus, is of benefit only when combined with prolonged drainage through the perineal wound. It may, again, be advantageous when the bladder is rigid and contracted. The incision is made into the urethra in the median line of the perineum at the apex of the prostate; the obstructing portion of the prostate is then divided with a probe-pointed bistoury and the channel enlarged by forcing the finger through to the neck of the bladder.

4. Prostatectomy (*a*) through the perineum is indicated under the same conditions as prostatotomy, and may be performed as a further step of that operation if the perineal distance permit the growth to be

[1] *Brit. Med. Journ.*, May 23, 1891.

reached by the finger, and it is found to be of small size (and limited to the median line posteriorly), or pedunculated and acting like a ball-valve at the neck of the bladder. The latter condition may be suspected where in old men, without marked prostatic symptoms and with no calculus, sudden and complete retention comes on, and still more especially if there has been sudden stoppage of the stream during urination, and if in spite of these symptoms catheterization is not difficult. The projecting portion may be seized by the finger or forceps, or caught with a wire or with a galvanic écraseur, and removed. The results have been remarkably good. The chief objections to the method, when a radical operation has been determined upon, are that in only about one-third or one-fourth of the cases (Watson, McGill) could the growth be reached by the finger; that often even when accessible to the finger it cannot be satisfactorily dealt with through the narrowed urethra; and that vesical projections are altogether beyond reach for accurate or careful manipulation.

(*b*) Suprapubic prostatectomy is in every regard the most convenient operation for the direct removal of prostatic overgrowth. Its principal advantages over the perineal method are in substance thus set forth by McGill:[1] The removal of the obstructing portions of the gland can be accomplished with great precision and certainty; complete and efficient drainage is assured, as experience has proved, although the contrary might be supposed; and, finally, the operation of itself is no more dangerous than when the perineum is opened. The mortality for this operation is only about 16.6 per cent. for all cases—a small percentage when the usual exhausted condition of the patient when presented for operation is taken into consideration. In a series of 12 cases performed by Mayo-Robson[2] only one death resulted from this operation; 3 of these cases are probably included in McGill's statistics of 24 suprapubic operations with 5 deaths.[3]

The difference in mortality between these two operations—viz. perineal and suprapubic prostatectomies—is not very serious. The last half of Moullin's table[4] shows for the suprapubic operation a mortality of 14.9 per cent., while for the perineal operation the mortality is 14.3 per cent.[5]

The operation up to the time of opening the bladder is performed in the same manner as for suprapubic lithotomy, except that the rectal bag must not be quite so much distended with water as in that operation. The patient should be placed in the Trendelenburg position, and the bladder should be distended with boric-acid solution until it is palpable above the pubes. When the bladder has been opened and the edges of the wound secured by ligatures passed into the deeper tissues of the abdominal wall, the obstructing lobes of the prostate may be enucleated by cutting through the mucous membrane covering them, and then by breaking free the capsule with the finger they may be quite readily loosened and removed. The "middle lobe" when pedunculated may be removed by cutting through its base with scissors. Hemorrhage must be controlled by irrigation with very hot water. Suprapubic drainage is always necessary for at least two or three days after operation.

[1] *Op. cit.* [2] *Brit. Med. Journ.*, July 14, 1894. [3] *Ibid.*, Oct. 19, 1889.
[4] *Harveian Lectures*, 1892. [5] White: *Ann. of Surgery*, 1893, vol. xviii. p. 178.

The operation does not always result in a complete cure, owing to the fact that, from the previous constant distention, the bladder-walls have become so weak that they are no longer able to expel the urine. The relief from the cystitis and congestion, however, together with the greater facility for catheterization, render the operation justifiable even when the atony of the bladder is foreseen. As much as possible of the hypertrophied gland should be always removed. It is the operation which must be compared as to results and mortality with castration, and is to be preferred to the operations already described in all cases where palliative treatment has failed and there are unmistakable indications that while the general health remains as yet unaffected the local conditions are growing worse. The best possible period is that before the development of marked and continuous cystitis, while some power still remains in the vesical walls, and the bladder is neither thinned and dilated nor rigid and contracted.

Under these circumstances—where a patient reports that he is disturbed at night with increasing frequency; that he is obliged to use the catheter oftener, and not only with greater discomfort, but with less relief in the interval; that the urine is occasionally turbid and offensive; that he has recently had one or more attacks of retention; and that he is beginning to lose flesh and appetite—it appears to me that the indications for operative interference are unmistakable, and that double castration and suprapubic prostatectomy are obviously the operations to be considered.

5. *Castration* for hypertrophy of the prostate was first advocated in 1893,[1] by the present writer since when the operation has been performed a number of times with results which cannot but be pronounced gratifying. Before recommending the operation, a series of experiments were performed on dogs, which demonstrated, beyond a peradventure, that rapid atrophy of the prostate followed the removal of the testicles.

It was the apparent analogy between the uterine and prostatic growths which led me to the investigation that resulted in my suggesting this operation to the profession. This analogy, as it is part of the present argument (Velpeau, Thompson, White), may be briefly restated as follows: The prostatic vesicle is the analogue of the sinus genitalis in the female—the uterine and vaginal cavities; the structure of the prostate and that of the uterus are strikingly similar, and would be almost identical if the tubular glands found in the inner walls of the uterus were prolonged into its substance; the histology of its growths, from small encapsulated tumors easily shelled out, or polypoid growths intimately connected with the uterus or prostate, up to the enormous growths which far exceed the original bulk of the organ itself, are identical; or there may be in either case a general hypertrophic enlargement affecting the whole organ; lastly, these disturbances occur at about the same time in the sexual life of the two sexes; that is, during the latter half of the reproductive period. This ends sooner in the female than in the male, and accordingly we find the growths appearing in the former at a somewhat earlier age. This analogy is said by the embryologists to be without foundation as regards any true homology between the prostate and the uterus. The clinical resemblances between the two forms of over-

[1] *Ann. of Surg.*, Aug. 1893.

growth are, however, none the less striking, and it may now be said that the results of castration in such cases are equally similar and remarkable in both sexes. I am quite willing to accept Moullin's way of stating it: "Enlargement of the prostate bears the same relation to the testes that fibroid disease of the uterus does to the ovaries. But the fact that they bear the same relation to two different organs is no proof that they bear any relation to each other." I must add, however, that even although the prostate is not the absolute homologue of the uterus, as it contains and encircles the cavity which is said to be the absolute homologue—*i. e.* the utricle or prostatic vesicle—the relationship between the two is notably close. So, too, although the uterine growths begin as fibro-myomata and the prostatic as adenomata or adeno-fibromata, the difference merely corresponds with the differences in structure of the two organs, the prostate containing normally more glandular tissue than the uterus.

I may seem to hold this view with unwarranted persistence, and I do not desire to undervalue the arguments against it; but it must be remembered that we have no other which at all explains either the cause of the growths, their spontaneous disappearance (or failure to appear) at a certain time of life, or their cure by castration. I said long ago that even if the theory of analogy were true, it could scarcely be said to be a full explanation of the occurrence of the prostatic growths, but by allying them to a well-known group of tumors would certainly bring us a step nearer to their comprehension. Its provisional acceptance with this statement is not therefore to be regarded as "concealing our ignorance,"[1] but gives us a sort of working hypothesis which has certainly thus far stood the test of practical application.

The clinical evidence of the truth of the statement that the hypothesis has stood the test of practical application has been found in the history of many cases which I have already published.[2] In view of the importance and the novelty of the subject I may be pardoned for summarizing here three of these cases, each of which was seen by several observers, and in regard to which there are fairly complete details:

Case 1.—The patient, aet. 60, weight about one hundred and thirty-five pounds, a carpenter by trade, was admitted to the University Hospital, Nov. 16, 1894. He was much broken down by long-continued suffering, but was exceptionally intelligent for a hospital patient. He had begun to have symptoms of prostatic obstruction eighteen months previously. He had undergone various forms of internal treatment, in spite of which he was urinating hourly. He had used the catheter with increasing frequency for years. His distress had become so great that he came for advice and a rest in the hospital. He was examined by me, by several assistants, and by two members of the class. His prostate was estimated to be of the size of a small orange. The finger could not reach the upper border. The lateral enlargement was very marked, the borders of the gland nearly touching the ischiatic rami. It was moderately firm and slightly elastic upon pressure. A soft catheter went in with a little difficulty. Urine began to flow when the eye was about ten inches from the meatus. The amount of residual urine averaged six ounces. He was using a catheter from four to eight times

[1] Moullin: *op. cit.*, p. 39.

[2] *Ann. of Surg.*, July, 1895.

daily, and urinating, or attempting to urinate, from twelve to twenty-five times, occasionally oftener, in the twenty-four hours. The urine contained blood and pus, but no casts. It was offensive and loaded with mucus.

Castration was advised, but was refused. He was admitted to the ward, the bladder was irrigated daily, and the urine sterilized as far as possible by the administration of salol and boric acid; recumbency with the pelvis slightly elevated was maintained and the diet carefully regulated, milk being chiefly given. He got some relief from these measures, but there was no change in the quantity of the residual urine. He was taught the proper use of the catheter and instructed how to keep it sterile, and left the hospital. On December 5th he returned and said that he was so much worse that he was ready for operation. This was performed November 12th in the presence of the class. Ether was used; the time of operation, including stitches, was three minutes. Improvement in urination was manifest in the first twenty-four hours after operation. In a week the patient emptied the bladder easily and painlessly; the urine was clear; the frequency of urination had decreased to five or six times daily. The residual urine, as reported by Dr. Small, the resident physician, had diminished to half a fluidounce, and on December 26th but one fluidounce remained after urination. This was verified by Drs. Martin and Wood. He was examined, before the class, five days after the operation, and the prostate was found to be merely a flattened fibrous mass, the upper border easily reached, the lateral borders shading off insensibly, so that the limits in these directions were difficult to determine. The bulging into the rectum, previously so unmistakable, had disappeared. The prostate itself might almost be said to have disappeared. A catheter inserted eight and a quarter inches drew a few drops of urine. The patient described to the class the change in the character of his urination, and said that he then felt as he did "when he was a boy in the fields." He remained as a helper in the surgical ward for four months. During this time he had on three occasions a little increased frequency of urination, each time associated with digestive disturbances. He left the hospital apparently entirely cured. Dr. R. H. Fitz of Boston examined the prostate *per rectum* a short time before the patient's discharge and stated that "it was so soft and so small that its outlines were indeterminate. The prostate and the wall of the bladder felt very much alike."

Case 2.—Dr. Beach of Boston kindly sent me some time ago the following interesting notes: "Patient seventy years of age, tuberculous family history. His habits had been good; not addicted to the use of tobacco or alcohol. No history of venereal disease. Had always enjoyed good health until ten years ago, when he was obliged to pass his urine frequently and in small quantities. He had never been catheterized. Entered the hospital Nov. 13th with his bladder much distended and his urine continually dribbling from him. By the rectum, the prostate gland was found to be much and uniformly enlarged, extending nearly to the ischium laterally and as far as the finger could reach posteriorly. In front, it projected at least an inch above the superior line of the pubes. The tunica vaginalis of the left side was moderately distended by a hydrocele. Upon examination of the urine it

proved to be free from sugar—s. g. 1020—containing a trace of albumin and a large quantity of pus and bladder epithelium. The urine was drawn by a soft-rubber catheter, carefully sterilized, twice daily. Meantime there was some dribbling. Mentally, he had been failing for a number of weeks. He remained in bed all the time, barely rousing enough to open his eyes when spoken to sharply or reminded of the necessity of passing his urine, and then would lapse again into the same dull and listless condition. The drowsiness slowly increased to deep stupor. By the 23d he ceased to pass any urine, and the quantity drawn by catheter each time became less. Dec. 5th, catheter entered with difficulty on account of the obstructing prostate gland. Dec. 6th, no urine passed for twenty-four hours. It had become impossible to pass either a silver, gum-elastic, or a soft-rubber catheter (this including various sizes of each, and the probe-pointed and Mercier-tipped elastic instrument). Suprapubic puncture and withdrawal by aspirator of the bladder contents. The hydrocele has increased to three times its size upon entrance. Dec. 7th, same condition, mentally and physically. Aspiration of bladder, and an unsuccessful attempt made to enter by catheter afterward. This was repeated on the 8th, 9th, and 10th, when, after the aspiration, it was possible to enter a soft-rubber instrument and to tie it in place. As soon as the patient was left for a few moments he pulled it out. The patient was examined by Dr. J. C. Warren, who concurred with Dr. Beach upon the condition of the patient and the expediency of an attempt at relief by castration. Dec. 11th, castration. Afterward the catheter was easily introduced and bladder emptied. 13th, no difficulty in catheterization since the operation. Bladder washed out twice daily. 14th, mental condition improving. A little dribbling of urine between the times for catheterization. 20th, has improved steadily, and to-day passed three ounces of urine without a catheter. 23d, prostate examined carefully by those who had examined it before operation, and found to be at least one-third less in volume. It no longer projects above the pubes. 27th, up to-day for the first time. Jan. 2d, improvement continues. Passed several ounces of urine without catheter. 8th, patient passed catheter to-day without assistance; later eight ounces of urine without assistance. Has walked a few steps. Is clear and intelligent. 9th, during the past twenty-four hours has passed all his urine without catheter. Wound healed. There has been as much improvement mentally as physically."

Case 3.[1]—"Mr. M———, a private patient in Mt. Sinai Hospital in Dr. Gerster's service, was fifty-six years of age and the father of a family. He was a merchant by occupation, and lived in one of the Southern States. For about ten years he had been troubled with frequent micturition, with occasional attacks of vesical tenesmus, and with a gradual increase in the severity of his symptoms. About three years before coming to the hospital he had been catheterized for an attack of retention, which, however, was of short duration. Still, from this time he had to be catheterized with gradually increasing frequency until, on admission to Mt. Sinai, he was in constant pain and felt an urgent desire to urinate at least once an hour during the night. By day his

[1] Lilienthal, *Med. Record*, Apr. 20, 1895.

condition was much worse, the attempts at emptying the bladder occurring about every five to fifteen minutes. His urine was alkaline, and there was a severe cystitis, with great quantities of pus and bloody mucus. A full-sized sound entered the bladder without difficulty. Dr. Gerster examined the prostate *per rectum* and found it enlarged to about three times the normal size, but the cystoscope showed a well-marked middle lobe, which was thought to be responsible for the trouble in evacuating the bladder. For six weeks the patient was treated by catheterization, washings of the bladder, diuretics, oil of wintergreen, and other internal antiseptics, but without improvement. Indeed, the man grew constantly worse. He was now emaciated, was thoroughly exhausted, and in a truly desperate condition. Dr. Gerster had proposed castration, but the patient had refused. The service now changed, and I came on duty. At my first examination of the prostate *per rectum* I found the gland about as big as a good-sized egg, not particularly tender to touch, but very firm and resisting. I made no cystoscopic examination, but accepted the positive observation of Dr. Gerster. When castration was again proposed the patient had become so hopeless that he decided to take his chances with the operation. At my request Dr. Fluhrer saw Mr. M——— and examined him. He also diagnosed the case as one of enlarged prostate, and, on learning that the treatment above outlined had been followed by no improvement whatever in six weeks, he agreed with me as to the advisability of castration. On February 9th, under chloroform anæsthesia, I removed both testicles, which were nearly normal. There were signs of very slight bilateral epididymitis. The wounds were closed without drainage and the patient was out of bed in six days. The patient was catheterized every six hours, and his bladder was washed twice daily. For the first twenty-four hours there was a slight remission of symptoms, but on the third day he was almost as bad as ever. From the fifth day there was, however, steady and miraculously rapid improvement. Before the operation, and immediately after, he could urinate only by drops, and there was always four to six ounces of residual urine. If he had allowed his bladder to become distended, practically all the urine was "residual," so that frequently at such times, after the man had exhausted himself trying to pass his water, ten ounces were withdrawn by catheter. The first improvement noted was that the patient could pass a stream. The residual urine rapidly diminished, the cystitis vanished, and in four weeks I presented him at a meeting of the Genito-urinary Section of the New York Academy of Medicine. At that time he could hold his urine two hours at a time without discomfort, he passed a moderately powerful and full stream, and, best of all, there was but one ounce of residual urine. The urine still contained some pus, but no mucus. It was acid and of the normal color. The man had gained many pounds in weight and enjoyed life. He could go to the theatre and could make the journey to Brooklyn, where he had relatives, without suffering by the way. It is needless to say that he is most grateful for what has been done for him. He does not for an instant mourn the loss of his testicles. No cystoscopic examination was made after the operation, but by the rectum the prostate, though still enlarged, is only about half the size it was before, and feels flaccid. Both Dr. Gerster and Dr. Fluhrer have seen Mr. M——— since his recovery,

and express themselves as thoroughly convinced of the efficacy of the operation in this case. A few days ago the patient returned to his home. Before leaving he again came to thank me, and to say that catheterization was no longer necessary, the amount of residual urine being so small. I still advised the use of the instrument, however, once in two days, until there should be no residual urine."

These three cases bring up all the points which have thus far been in dispute as to the cases reported as "successful." The critics of the operation have said (*a*) that they still regard it as a physiological experiment; (*b*) that the reported cases lacked detail, and did not prove that the same results would not be obtained by rest in bed, careful catheterization, regulated diet, etc.; (*c*) that the subsidence of the symptoms and of the bulk of the gland, as reported, was too rapid to be due to atrophy, but must be owing to the disappearance of congestion and œdema; (*d*) that, at any rate, a true hyperplasia could not disappear in so short a time as has been reported; (*e*) that the estimates both of the size of the hypertrophied gland and of its reduction in size were inaccurately expressed; (*f*) that it was unreasonable to suppose that a long-standing cystitis would vanish even if the prostate did shrink; (*g*) that a vesical calculus in a post-prostatic pouch might be overlooked and only discovered later; and (*h*) that the cases had not been observed for a sufficient length of time to make the results trustworthy.

I shall try to reply briefly to these assertions, basing my statements chiefly on the facts already published.[1]

a. It seems to me that even a few such cases as those described above remove the operation from the region of experiment to that of practical surgery, and show that it is at least as scientific and as certain in results as many of our accepted operative procedures. Of 102 cases, in which the condition of the prostate is noted, 65 (or 37 per cent.) are reported as showing some distinct decrease in size, while in 34 additional cases—99 in all (97 per cent.)—the improvement in other symptoms renders the conclusion justifiable that the prostate has become smaller. In two cases autopsies have been made which demonstrate the exact nature of this shrinkage, and show that it is due to the same sort of atrophy (first of the glandular elements and then of the stroma) that I reported two years ago as the invariable result of castration in dogs.

b. There will be found also in the published cases, in addition to those I have detailed, many cases which had previously been treated by various palliative measures, including, of course, rest in bed, catheterization, vesical irrigation, etc. The statement that the reported improvement could have been brought about by these means rather than by operation seems to me, in the face of the evidence, scarcely worthy of further attention. The palliative treatment of prostatic hypertrophy is now understood by every general practitioner, and I frequently find, in cases which I see in consultation, that every possible care has been taken and the best judgment shown in the use of the catheter, the regulation of diet, the hygiene of the patient, etc. It is inconceivable that many of the operators in these cases should have overlooked such obvious preliminary measures.

[1] *Annals of Surgery*, July, 1895.

c. The assertion that the subsidence of symptoms has been due to the disappearance of congestion and œdema is largely negatived by the facts already given—viz. the previous failure of palliative measures and the pathological evidence of actual atrophy. Certain facts which seem to afford an explanation of the rapidity of the improvement in many cases, which, as Lister has said, is "as remarkable as it is satisfactory," ought to be mentioned. All the varieties of enlargement have the same histological structure, but it is interesting to note the following observations which seem to have a definite relation to one another. Sir Henry Thompson long ago[1] called attention to the fact that the posterior part of the so-called "median lobe" ("median portion," "prostatic commissure," etc.) contains a larger portion of glandular structure than most other parts of the organ. This is demonstrated microscopically. It has been confirmed by others. Owing to its anatomical position the variety of hypertrophy which affects this region is of chief pathological importance. Watson has found it present in 27 out of 30 cases examined by him. Nearly all the varieties of enlargement are probably originally adenomatous, but such growths would naturally begin where glandular tissue was most abundant.

Griffiths[2] and Kirby[3] have shown that after castration it is the glandular tissue which first atrophies and disappears, and that this atrophy begins within a few days. A consideration of these circumstances seems to make the rapidity with which favorable changes, such as ability to urinate (66 per cent.), ease of catheterization (about 75 per cent.), etc., have occurred in some of the cases more readily understood. A very little diminution in a growth largely adenomatous and occupying this particular region would undoubtedly be at once attended by a noticeable amelioration of obstructive symptoms.

d. As to the disappearance of the hyperplasia, it must be remembered that the stroma consists largely of unstriped muscular fibres. Griffiths has shown[4] that "the intrinsic muscle-fibres of the prostate are subservient in function to the glandular tubules, and that in the developing prostate the muscle could be seen running in fine bundles in close relation to the tubules, and in such a manner as to be capable of exerting compression upon them."

Moullin says:[5] "The stroma of the prostate, like the glandular tissue it supports, belongs to the sexual organs. It has to do solely with the discharge of the prostatic fluid, and, as Dr. Griffiths[6] has shown, its development varies with that of the sexual organs. After castration it wastes as rapidly as the gland-tissue." These facts would seem to explain satisfactorily the practical disappearance of the bulk of the gland, which has been said, for *a priori* reasons, to be impossible.

e. As to the lack of accuracy in the estimation of the original size of the gland, and therefore in the statements regarding the exact degree of reduction in bulk, it must of course be admitted that precise measurements are both desirable and difficult. But while it is not easy to express the dimensions of the enlarged prostate in figures, there is no

[1] *Diseases of the Prostate.* [2] *Brit. Med. Journ.*, March 16, p. 579.
[3] *Annals of Surg.*, Aug., 1893.
[4] *Journal of Anatomy and Physiology*, vols. xxiii. and xxiv.
[5] *Op. cit.*, p. 748. [6] *Loc. cit.*

trouble by combined instrumental and rectal examinations in making a close estimate and drawing a fair comparison with some well-known objects like a "walnut," a "lemon," an "orange," or a "base-ball," all of which terms are used by the gentlemen reporting cases, and all of which convey a reasonably exact idea of bulk to the average mind. As to the change in size, almost any operator has enough of the *tactus eruditus* to know whether or not a given body has shrunken one-half or one-third, or has decreased from the size of a lemon to that of a filbert.

f. The disappearance in many cases (52 per cent.) of a previously intractable cystitis has certainly been a surprising phenomenon. But, after all, it is in accord with certain well-known facts. The prostatic plexus of veins receives nearly all the return blood from the bladder. Congestion of this plexus is one of the most common and invariable phenomena associated with enlargement of the prostate. The veins attain a relatively enormous size, their valves disappear, and the backward pressure inevitably produces congestion and swelling of the vesical mucosa.

Septic infection of a healthy mucous membrane by the pyogenic microbes of acute or chronic cystitis is not possible, as Guyon, Albarran, and others have shown, even though such bacteria are present in the urine; when, however, the vesical mucous membrane is congested in consequence of obstruction to venous return and by distention of the viscus and frequently recurring contractions of the detrusor muscles, it offers but slight resistance to the microbic invasion. The pyogenic microbes are generally carried to the bladder by septic instruments, or, if these are rendered sterile, through failure to cleanse the anterior urethra before the instrument is introduced into the bladder. Often cystitis develops independently of the use of instruments, probably as a result of infection conveyed by way of the urethral mucous membrane. The pathogenic microbes usually found are the bacillus coli communis and the staphylococcus pyogenes aureus. These cause vesical lesion either by direct action or indirectly through their ptomaïnes, and, acting upon the urea, produce ammoniacal decomposition. The ammoniacal urine in its turn acts as a powerful irritant to the bladder-walls, but is the effect, not the cause, of the cystitis.

Now, if the backward pressure is suddenly relieved and the vessels have an opportunity to regain their normal calibre, and the bladder to empty itself more readily and more completely, it does not seem so unreasonable to suppose that microbic multiplication would cease; healthy epithelium with normal resistant powers would prevent further infection; the urine could be voided before its urea had undergone decomposition, its normal acidity would thus be re-established, and a virtual cure of the cystitis be effected.

According to Keyes,[1] "Fels and Ritter, by inoculating the bladders of dogs, produced therein ammoniacal urine and cystitis, but only on condition of ligating the urethra; upon loosening this ligature the bladder promptly resumed its condition of health." The shrinkage of the prostate seems to be the "loosening of the ligature" in many of these cases.

The subsidence of the tenesmus, which is often so severe as to produce lesions of the mucous membrane at the neck of the bladder, and the

[1] *Am. Journ. Med. Sci.*, June, 1894.

avoidance of similar lesions often caused by even the most careful use of the catheter, are, of course, important factors in bringing about a disappearance of the cystitis.

g. The lessening in the length of the urethra cannot possibly be, as has been suggested, merely the effect of relieving an overfull bladder, as Finger has shown[1] that the urethra is shortened by vesical distention. Now, as a rule, the measurements in these cases of castration have been made originally with the bladder more or less distended, and later with the bladder nearly or quite empty, so that the reported improvement is probably understated rather than exaggerated. If the atrophy of the prostate is once admitted, however, the change in the urethra requires no further explanation.

h. The return of power in the bladder has been in some cases (66 per cent. of the cases collected by me) as surprising as the disappearance of the cystitis. It is now quite certain that Sir Henry Thompson's assertion, that the return of voluntary power in the bladder is impossible after two years' use of the catheter, is incorrect. There has been much variation in this respect in the recorded cases. So far as I know, there is no *certain* method of determining in advance whether a particular bladder is hopelessly dilated and atonic, or still possesses power of recuperation. Of course in many cases the evidence of continued contractility will be unmistakable. But even after complete retention, with the withdrawal of urine exclusively by the catheter for years, there has been noted a satisfactory return of power in the detrusors, in some instances almost amounting to perfect health.

i. The possibility of operating in the presence of an undetected calculus does not seem to me a very grave objection to the operation. The most unfavorable subjects for litholapaxy and for all forms of lithotomy are the advanced prostatics with cystitis and deep post-prostatic pouches. If castration will, even in a minority of such cases, mitigate the vesical inflammation and wholly or partially obliterate the post-prostatic pouch, it certainly will be deliberately adopted as a preliminary operation by many surgeons. I did this in one case with the most satisfactory results. If the stone chanced to be found after instead of before castration, I cannot see that any serious difficulty would follow. Its removal, if prostatic atrophy had occurred, would be an operation certainly both easier and less dangerous.

j. The assertion that the cases have been reported prematurely before the result was assured is true of some, but certainly not of all. The successful cases among those collected by me may be grouped as to the time of report in three classes: 1. Those reported immediately after operation—*i. e.* within the first two or three weeks, and from which nothing further has been heard; these number 7, or 8.7 per cent. 2. Those in which from a month to three months elapsed before the patient passed from observation, and in which the prostatic changes and the improvement in symptoms were carefully noted; these number 16, or 20 per cent. 3. Those observed after three months, and in which the local changes seem to have reached their culmination and the health of the patient appeared to be permanently re-established; these were 57 in all, a percentage of 71.3.

[1] *Gonorrhœa and its Complications*, 1894, p. 34.

It is obvious that enough cases have been followed for a sufficient length of time to warrant belief in the permanence of the cure when once effected. That there may be remote general effects from the operation, not now known or appreciated is of course a possibility. But it seems unlikely that anything new will be observed in this respect, as castration is one of the oldest known operations, and has been investigated both as to immediate and remote consequences with great detail and thoroughness.[1]

The legitimate average mortality in cases operated on with a reasonable expectation of cure seems to show 7 deaths in 98 cases—a mortality of 7.1 per cent. It will probably be less in the future. If so, it will accord with the history of every new operation in the matter of mortality. A table of 95 cases of suprapubic prostatectomy, arranged chronologically, shows, as I pointed out in 1893, a mortality of 20 per cent. for the whole number, but of only 15 per cent. for the last half; the mortality of the first half was 25 per cent.

I think a careful and impartial study of the fatal cases thus far reported will show that in every one where details are given there was little to be expected from palliative operations, and less from the unaided efforts of nature, while it seems highly probable that any other radical procedure would have been at least equally likely to result fatally.

Moreover, even in these desperate cases it is most interesting to note that 15 (75 per cent.) of the 20 collected by me showed some distinct improvement in symptoms or some shrinkage of the prostate before they died.

But while there is little or no risk in the operation itself, if it be applied in the future as widely as it has been already—*i. e.* to patients of all ages and all degrees of weakness, of uræmia, and of toxæmia—it will undoubtedly always have a considerable mortality. The average age of 86 patients, whose ages were given, is 66½ years; the average age of the 14 cases among those who died, in which the age was given, is between 69 and 70 years.

Although the years of the patient must be an important factor in determining the result in this as in other operations, it is the *real* age which counts rather than months and years. The senility of the tissues, the degree and extent of arterio-sclerosis, especially as affecting the integrity of the kidneys, are more important than the nominal age. This varies widely in just these cases, the relationship between general atheroma and prostatic enlargement being so close that so distinguished an observer as Guyon has, as I have already mentioned, based upon it a theory of causation. I am strongly of the opinion that when we have enough detailed cases for broad generalization we shall find that the mortality of this operation will have a very direct relation to a few factors, the most important being the presence or absence of renal infection and the history of long-continued catheter-life, or of a number of attacks of complete retention, or of a very large amount of residual urine. If these factors are conjoined, the case is of the most unfavorable type, since the suppurative disease of the kidneys, following infection, cripples to the point of uselessness organs already suffering from the effects of prolonged backward pressure.

Differences in the size, the density, and the shape of the prostatic

[1] See Mojon: *Mémoire sur les Effets de la Castration dans le Corps humain*, Genes, 1813.

overgrowth will probably be found to be minor factors in determining mortality, and more important ones in relation to the degree of improvement effected by the operation and to the rapidity with which that improvement occurs. After careful study of the cases, I do not think we have the data for positive conclusions on these points. Of 110 cases,[1] only 19 were definitely stated to have been unimproved at the expiration of varying periods. Of these 19, 9 were included in a table of deaths, leaving only 10 per cent. of apparent failures. But, as in many of the whole number no mention is made of the density of the overgrowth and no estimate of the size, it is impossible to say whether or not these failures were due to the fact that in these cases the enlargement was of the hard and fibrous variety, with an abundance of connective tissue and relatively little glandular structures. Prostates assumed to be of this kind of enlargement have been reported as shrinking with rapidity, but, of course, the observers may have been mistaken. It is encouraging to note, however, that the microscopic studies thus far made seem to indicate an atrophy of the stroma almost as rapid as that of the glandular element. The remote results of the operation cannot yet be determined. The cases of death with precedent mental symptoms described as "mania," "acute mania," "childishness," etc. are only such as every surgeon is familiar with in a certain proportion of cases of operation on aged persons, whose mental equilibrium is easily disturbed, and can have no bearing on the question of later mental changes as a result of the castration. With greater accuracy we should probably classify the large majority of them as "uræmia," and some of the remainder as "traumatic delirium." It is worthy of note that no mental or physical changes whatever, other than favorable, have been noted in a single instance of all the successful cases, whereof some now date back nearly a year and a half. All the information we have on this subject—and it is far from scanty—leads to the belief that the removal of the testicles from persons who have reached full adult life, and *a fortiori* from aged persons, has no harmful effect whatever on the mental functions or on the general physical characteristics. Impotence will undoubtedly be caused in the majority of cases, but even this is not inevitable.

Properly to compare this operation with the other methods employed in the treatment of prostatic enlargement, it seems necessary, as its position is still so indeterminate, to review briefly the procedures appropriate to various conditions and stages of hypertrophy:

1. *Dilatation.*—A patient who presents the symptoms of the prostatovesical congestion of the early stages of hypertrophy, who is disturbed once or twice at night, who has an enlargement of moderate density, appreciable through the rectum, but not offering much resistance to the introduction of an ordinary catheter, and who has but little residual urine, is likely to derive great benefit from the systematic introduction of full-sized steel sounds. This treatment alone often seems to relieve the symptoms, and to prevent, or at least delay, the development of further trouble. Of course, while this is the case, no more radical treatment would usually be considered.

2. *Catheterization* should be systematically employed in cases in

[1] White: *loc. cit.*

which the quantity of residual urine is three or four ounces or more, and where the introduction of the instrument is easy and painless and the urine is sterile. The frequency should be proportionate to the amount and character of the residual urine: a very good working rule is, if the urine be sterile, to use the catheter once daily (preferably at bedtime) for three ounces, twice for six ounces, and then once more for every additional two ounces. When the urine is sterile it is rarely necessary to use the catheter oftener than once every four hours.

3. *Radical Operation.*—If the operation of castration holds its own, it will be because it has some advantages over prostatectomy. I believe that those advantages exist and are as follows: (*a*) The mortality of the first extensive series of suprapubic prostatectomies published was 25 per cent. The mortality shown by my table of a slightly larger number of cases of castration is 18 per cent., including deaths which followed even months after operation. The true mortality, as I have already said, I believe to be 7.1 per cent. The death-rate will be lower in the future in both operations, but the proportional difference in favor of castration will probably persist or increase, as castration is a simple, easy, rapid procedure, without danger *per se*, and requiring for its safe performance only a proper selection of cases. It seems to me not unfair to add that in the present instance the facts were obtained largely by personal solicitation, and that unfavorable cases have not been suppressed. (*b*) The return to local and general health in the successful cases has been more complete and vastly more rapid than after prostatectomy; a re-establishment of almost perfect health appears to have occurred in 51 cases (51.2 per cent.[1]) within four to twelve weeks. (*c*) Vesical contractility was re-established, cystitis disappeared, and all pain ceased in such a large proportion of the successful cases that it seems unlikely that any operation which opens the bladder and necessitates healing by granulation will secure equivalent results; certainly suprapubic prostatectomy has not done so. (*d*) A permanent fistula may follow suprapubic prostatectomy, and prove a continual source of annoyance even when all the other results have been favorable. (*e*) It is too soon yet to compare the relative dangers of relapse. One case is, however, interesting in this respect. The patient had been taught to use the catheter for himself after a suprapubic prostatectomy in October. In February he returned because the introduction of the instrument had become impossible. Although more than 70 per cent. of the cases of castration in the table had been observed for three months, in not a single case did relapse occur.

I concluded my paper in 1893 with the remark, "that if we ever reach a point in certainty of knowledge in this direction comparable to that already attained in regard to oöphorectomy in relation to uterine fibroids, and can promise equivalent results, there will be no lack of cases willing to submit to an operation almost painless, with a low mortality, and followed by no such unpleasant conditions as accompany persistent fistulous tracts, either suprapubic or perineal, even although the operation carries with it the certainty of sacrificing whatever sexual power has survived the excessive and often intolerable sufferings of such patients."

[1] Exclusive of Moullin's 10 cases.

I find that Greig Smith says[1] that the general mortality of oöphorectomy for myomata is somewhere near 10 per cent. He adds: "As to the results, we may, in every 13 cases of recovery after operation, reckon upon complete cure—*i. e.* shrinking of the tumor and menopause—in 10 cases, improvement in 2, and failure in only 1." An examination of the table of castrations shows that with Greig Smith's computation as a basis we may in every 13 cases of recovery count upon 11 being complete cures in the sense of shrinking of the tumor, 1 being improved, and 1 being unsuccessful.

The analogy which I have always thought so remarkable between the two conditions and the indications for operation, is thus even more strikingly illustrated by the results, and the number of cases already reported amply justifies the prophecy I ventured to make in regard to the willingness of patients to be operated upon.

Fenwick has performed this operation 8 times for enlarged prostate, and obtained improvement in 7 (the eighth was too recent to be reported). He is inclined to think that the results have been slightly exaggerated in regard to the amount of atrophy which takes place in the prostate. In his opinion, the large, soft, elastic, uninflamed prostates are only slightly diminished after three weeks, and it is several weeks or months before they are decidedly small upon examination *per rectum*. With the congested enlarged prostate it may be otherwise.

His conclusions are:[2] "1. There is no doubt that slow shrinkage of the prostatic tissue in many of the forms of senile enlarged prostate ensues upon double castration. Further experience must, however, decide as to whether every form of prostatic growth is thus affected. 2. It is certain that escape from catheter-life after castration depends largely upon the health of the vesical muscle. The grade of the atony, therefore, should be most carefully estimated before any hopes of relief from catheterization are held out. To promise a confirmed catheter-case that orchectomy will do away with the instrument, may merely bring discredit on the operation and disappointment to the patient. Even after prostatectomy we are unable to promise such relief if the muscle is hopelessly atonic, and we cannot do so after castration. 3. It is possible that castration, by diminishing all microbic infection from the inflamed senile prostate, will remove a constant menace to the integrity of the kidneys, for it will control the most prolific source of ascending pyelitis.

"It appears that double castration will prove of value in the following conditions: (1) in reducing bulky overgrowth of the lateral lobes of the prostate; it may be found that the small, tough, fibrous median or lateral vesical outgrowths will be better removed by suprapubic prostatectomy; (2) in controlling the distress and danger of an inflamed senile enlarged prostate; (3) in lessening the frequency or difficulty of introducing the catheter in advanced or confirmed catheter-life; (4) in avoiding the mechanical difficulty of crushing a post-prostatic or a post-trigonal stone by levelling the base of the bladder, thus rendering the operation of litholapaxy feasible in a condition in which before it was impracticable; (5) in reducing chronic cystitis and recurrent phosphatic calculus in cases of confirmed catheter-life."

[1] *Abdominal Surgery*, 2d ed., p. 187.

[2] *Brit. Med. Journ.*, Mar. 16, 1895.

I have made a further study of the effects upon the prostate of unilateral castration, ligation or section of the vas deferens, of the spermatic and deferential arteries, and of the whole cord, and have formulated my conclusions as to the whole subject as follows:

1. The theoretical objections which have been urged against the operation of double castration have been fully negatived by clinical experience, which shows that in a very large proportion of cases (thus far in approximately 87.2 per cent.) rapid atrophy of the prostatic enlargement follows the operation, and the disappearance or great lessening in degree of long-standing cystitis (52 per cent.); more or less return of vesical contractility (66 per cent.); amelioration of the most troublesome symptoms (83 per cent.); and a return to local conditions not very far removed from normal (46.4 per cent.) may be expected in a considerable number of cases.

2. The deaths have been 20 in 111 cases, a percentage of 18. But of these there seem to be 13 that may fairly be excluded in an attempt to ascertain the legitimate mortality in patients operated upon under surgically favorable conditions—*i. e.* before the actual onset of uræmia or, better, before the kidneys have become disorganized by the two factors rarely absent in advanced cases—backward pressure and infection. This would leave a mortality of 7.1 per cent., which will probably be decreased as advancing knowledge permits of a better selection of cases. It is important to note that even in the desperate cases which make up this series of deaths, 15 (75 per cent.) showed improvement of symptoms or shrinkage of the prostate before they died.

3. Comparison with other operative procedures seems to justify the statement that, apart from the sentimental objections of aged persons on the one hand, and the real, entirely natural, and very strong repugnance to the operation felt by younger patients, castration offers a better prospect of permanent return to nearly normal conditions than does any other method of treatment. The relatively greater degree of improvement in successful cases should be considered, as well as the mortality, in comparing the operation with the various forms of prostatotomy and prostatectomy. So, too, should the absence of any risk of permanent fistulæ. perineal or suprapubic, the ease and quickness with which the operation can be performed, and the possibility of avoiding altogether the use of anæsthetics, which in these cases are in themselves dangerous.

4. The evidence as to unilateral castration is at present contradictory, but there can be no doubt that in some cases it is followed by unilateral atrophy of the prostate, and in two cases, at least, it has resulted in a very marked improvement of symptoms. It is worthy of further investigation.

5. My experiments on dogs have shown in nearly every case in which the vas deferens was tied or divided on both sides that without much change in the testicles there were beginning atrophy and considerable loss of weight of the prostate. These experiments need repetition and confirmation, as the absence of corresponding testicular change seems to make the results somewhat anomalous. It is possible that the inclusion or severance of small but important nerves may account for the effect on the prostate.

6. Ligation of the vascular constituents of the cord or of the whole

cord produces atrophy of the prostate, but, in my experiments, only after first causing disorganization of the testis.

Treatment of Atony of the Bladder.—Since this ailment frequently arises from the obstruction caused by an enlargement of the prostate, there is a fair chance that the bladder will regain its power if the obstruction be removed. It has done so, as has been shown, in a large number of cases. If Guyon's theory that it is due to general atheroma[1] were correct, there would be practically no chance whatever of the bladder's returning to the normal state. There is a certain proportion of cases in which the bladder will not regain its normal expulsive power, or at least only under very careful treatment. One single act of over-distention has been known to be followed by atony. Temporary atony always exists after complete retention from enlarged prostate, and many days, or even weeks, may elapse before the residual urine returns to its previous level. Cystitis as long as it is limited to the mucous membrane is not serious, but after it has lasted three or four years the damage is often irreparable.

Sometimes by medicinal treatment the complete or partial restoration of the expulsive power may be aided. Intravesical injections of strychnia and cold water have been recommended and have given fairly good results. Electricity applied to the bladder also may be valuable, but it should be used with great care, lest the little muscular power remaining be destroyed for ever.

VESICAL CALCULUS AND HYPERTROPHY OF THE PROSTATE.—Calculus-formation is the frequent sequence of retention of urine in an inflamed or congested bladder, and when the symptoms are more than usually severe in a case of hypertrophy, or when there is considerable hæmaturia independent of the passage of a catheter, or if the symptoms are much aggravated by exercise, the presence of a calculus may be suspected and a careful examination should be made. The elevation of the neck of the bladder by the hypertrophied gland, and the existence of a deep post-prostatic pouch, often make the detection of a calculus an extremely difficult, sometimes an almost impossible, task. In sounding for stone in such cases the chief difficulty is that the calculus becomes lodged in this pouch behind the prostate; to obviate this, the pelvis of the patient may be raised so as to allow the stone to fall back into the bladder, or possibly the stone may be dislodged by means of a finger introduced in the rectum. It is also often of service to use a hollow sound through which water may be injected, and thus drive the stone into a new position.

The calculi found associated with hypertrophied prostate are, almost without exception, owing to the state of the urine in which they are formed, composed of phosphates, and may be of rather firm consistence and large, or may consist of merely soft, putty-like masses, which can be easily broken up and washed away by means of a lithotrite and evacuator.

It may be readily seen that the presence of an undetected calculus might seriously affect the results obtained by castration, the calculus possibly keeping up the irritation long after the prostate had atrophied sufficiently to allow the urine to pass freely, and poor results would be set down as a failure of the operation. In such cases renewed explora-

[1] *Ann. des Mal. génito-urin.*, June, 1885.

tions with the vesical sound should be made after the subsidence of the overgrowth, when both the detection and the crushing and evacuation of the calculus may be infinitely easier. I have deliberately performed castration while a stone occupied a deep point behind the prostate, and later have performed lithotapaxy with great ease.

PROSTATIC CALCULI.—Small concretions, composed (according to Lassaigne, as quoted by Thompson[1]) chiefly of the calcium phosphates and calcium carbonates and animal matter, are occasionally found imbedded in the prostatic tissue or contained in small cysts or cavities. The larger masses which are sometimes found extending into the urethra, or even into the bladder, usually consist of an aggregation of several smaller concretions pressed closely against one another, so that by contact they are facetted and fit into one another at their edges. Such prostatic calculi are always of very dense consistency, often resembling porcelain; they are white in their interior, but usually pale-brown on the surface. They can be generally felt through the wall of the rectum, or they may be detected by the grating sound produced when a metallic catheter is introduced through the prostatic urethra. They are most frequently found in middle-aged men.

Small prostatic concretions seldom give rise to any symptoms, but, when large, by encroachment on the urethra, they may cause symptoms of obstruction and irritation similar to enlarged prostate.

Treatment.—I have on several occasions removed such calculi from the prostatic sinus by means of long-handled, short-beaked urethral forceps. In one case I extracted ten in this manner. The patient has remained perfectly well. A median perineal incision is the best means of removing the concretions when operation is required. For the very small calculi which pass spontaneously no treatment is necessary other than avoidance of everything which would tend to provoke irritation of the prostate or bladder, such as riding, sexual excitement, constipation, alcoholic drinks, etc. Pain or nocturnal frequency of urination will be controlled by suppositories of opium and belladonna.

TUBERCULOSIS OF THE PROSTATE.—The prostate is never affected with tuberculosis independently of other organs; similar tuberculous deposits will be invariably found either in the kidneys, in the testicles, or in the seminal vesicles. The glandular portion of the prostate is the first to be affected; the tubercular deposit appears as small millet-seed nodules which gradually enlarge, and by softening at the centre form numerous small abscesses. In Sir H. Thompson's tabulation of 18 cases[2] the ages ranged between eleven and seventy-six years; as far as can be gathered, no case has been recorded of an earlier age than the former. The assertion that in the young, the disease is due to excessive masturbation is probably a reversal of cause and effect.

There are no distinctive symptoms of the disease other than painful and frequent urination with occasional slight discharges of blood with the last few drops of urine; when the bladder and the kidneys are affected at the same time as the prostate, a frequent occurrence, characteristic symptoms of those complications will arise. The involvement of the prostate is to be regarded as merely a local manifestation of a general disease.

[1] *Dis. of the Prostate*, p. 222.

[2] *Ibid*, p.. 195.

Treatment must be directed chiefly against the constitutional disease with a view to improving the general health by careful attention to the diet, clothing, exercise, etc.; the bowels must be kept freely open, and any instrumentation of the urethra must be performed with the greatest gentleness in order not to irritate the prostatic urethra. If abscesses form in the perineum or in the ischio-rectal spaces, they must be opened and drained; if the disease seems to have affected chiefly the superficial portions of the gland, the necrotic portions may be scraped away with a dull curette. Marwedel, who has made a careful study of the pathology of this disease, recommends[1] injections of iodoform emulsion into the bladder.

TUMORS OF THE PROSTATE.—*Cysts.*—Serous cysts of the prostate are never found, according to Sir H. Thompson;[2] mere dilatations of the gland-follicles from obstruction are, however, frequently mistaken for them. Such retention-cysts are common in the prostates of elderly men, but rarely give rise to any symptoms. A second variety consists of those which appear to be formed around prostatic concretions or which remain after the discharge of an abscess.

It is extremely doubtful whether or not hydatids have ever been found in the substance of the prostate itself. Belfield alludes[3] to three authentic instances furnished by post-mortem records. They may be occasionally found in the space between the bladder and the rectum and encroaching upon the prostate; in this position they push the prostate aside, deflect the course of the urethra, and may occasion retention of urine. The only treatment is to puncture the sac, when it is possible to locate it.

Malignant Tumors.—Malignant tumors of the prostate are rare, either as primary growths or as secondary deposits or extensions of tumors primarily affecting other organs. The tumors most commonly seen are carcinoma and sarcoma. The soft or encephaloid cancer is the more common of the two. There is said to be no other tissue or organ from which there are such widespread metastases as from encephaloid of the prostate.

The **morbid anatomy** of the early stages of the disease is still obscure; death does not take place until all traces of normal prostatic structure are lost. The disease may be circumscribed at first, or may begin as a general malignant infiltration.

Whether circumscribed at first or not, the entire gland is soon involved, and the process rapidly spreads outside the limits of the capsule to the seminal vesicles, rectum, and ureters; secondary deposits in the neighboring glands soon make their appearance. Occasionally the iliac vessels are compressed by the enlargement of these diseased lymphatic glands, whereby thrombosis and embolism result, with the accompanying œdema of the legs.

Barth[4] of Marburg has lately reported three cases of sarcoma of the prostate, and opines that this form of tumor is by no means as rare as is generally supposed. All three of the cases reported by him occurred in patients under thirty; in one of the cases the patient was but nine

[1] *Beiträge zur klin. Chir.*, Bd. ix.; *Ann. of Surg.*, vol. xviii., 1893.
[2] *Op. cit.*, p. 196.
[3] *Morrow's System*, vol. i. p. 360.
[4] *Centralbl. für Chir.*, No. 26, and *Brit. Med. Journ.*, Supp., July 18, 1891.

months old. The disease was invariably fatal, in most cases within six months. According to Belfield[1] primary cancer of the prostate occurs chiefly in patients under ten and over fifty years of age, though the intermediate periods of life furnish not infrequent instances; and about seven-eighths of the tumors are carcinoma.

Symptoms.—The disease not infrequently begins in a prostate already hypertrophied, and consequently the symptoms are often masked by the existing symptoms of obstruction. When the disease begins *de novo*, the first symptoms may be the onset of an intermittent hæmaturia, together with some pain and difficulty on urination; the disease then usually advances rapidly, and cystitis, complete retention, and severe pain in the rectum, down the thighs, and in the perineum may render the case desperate within a few months.

Hemorrhage is an almost constant symptom; it may occur at the beginning, or at a late period, of the disease, and may be profuse or scanty. It is almost always intermittent, coming on after straining at urination, and appearing as pure red blood, chiefly at the end of the act.

When felt through the rectum, the prostate is at first hard and irregular, but if the patient live long enough, areas of softening will make their appearance.

Treatment.—Regarding this there is little to be said: it is purely palliative, and symptoms must be met as they arise. To allay pain opium must be given freely, but, to avoid constipation, cautiously; instrumentation should be resorted to only when absolutely necessary, and must be conducted with the greatest care and gentleness, lest it provoke serious hemorrhage and increase the irritation. When the hemorrhage is profuse, it may be often allayed by the application of cold to the perineum or cold douches in the rectum, or by the administration of fluid extract of ergot.

Suprapubic prostatectomy has been performed a number of times for malignant tumors, but the results have never been satisfactory; by the time that the patient is presented for operation the disease is too far advanced, and the lymphatic glands or neighboring organs are sure to be affected. In all of Barth's cases, quoted above, the patients died within a few weeks after the operation.

Atrophy of the Prostate.—In many of the wasting diseases and also in advanced age the glandular elements of the prostate may undergo a marked atrophy. Messer's table, already quoted from (p. 619), seems to establish this fact. According to Thompson,[2] phthisis may occasion a remarkable degree of atrophy in this gland; in one case which he had observed, the prostate from a man twenty-one years old, who died of phthisis, weighed only fifty-four grains; in another case, the gland taken from a man seventy-eight years old weighed but two drachms forty-five grains. Whether or not the testicles were atrophied in either of these cases is not mentioned. It is a pretty generally accepted fact that atrophy of the testicles is followed by atrophy of the prostate; nevertheless, Fenwick[3] has recently published some observations on the condition of the prostate in cases where there was either extreme atrophy or even absence of one testicle. In 5 of the 20 cases noted where the testicle

[1] *Morrow's System of Genito-urinary Dis.*, vol. i. p. 358. [2] *Op. cit.*, p. 180.
[3] *Brit. Med. Journ.*, Mar. 9, 1895.

was absent, either congenitally or from castration, or extremely atrophic from inflammation or other cause, the corresponding lobe of the prostate was found to be larger than the one communicating with a healthy testicle. These facts are brought forward by the author, not to prove that atrophy or absence of the testicles is not followed by atrophy of the prostate, but to show that atrophy of one testicle does not *necessarily* influence the growth of the corresponding lobe of the prostate.

Atrophy of the prostate is not accompanied by any **symptoms**, unless it be sterility.

Treatment is of no avail: there is nothing that will restore the lost function of the gland.

DISEASES AND INJURIES OF THE TESTICLES.

Classification of Anomalies of the Testicle (Monod and Terrillon).

Anomalies of Development.	In Number,	Excess,	Polyorchism.
		Deficiency,	Absence, Anorchism.
			Fusion, Synorchism.
	In Size,	Excess,	Hypertrophy.
		Deficiency,	Arrested development.
Anomalies of Migration.		Testicle undescended,	Lying in some part of the normal course.
			Lying outside of the normal course.
		Testicle descended,	Inversion.

ANOMALIES IN NUMBER.—1. *Polyorchism.*—Though there are many cases of supernumerary testes reported, it is probable that in not a single instance, except that of Blasius, was this anomaly really present, since every other case which has been subjected to absolute proof, by operation or by post-mortem examination, has shown that the supposed third testicle was an encysted hydrocele, an epiplocele, a fibroma, or some other comparatively common pathological condition. The size, shape, and even the peculiar pressure-sensitiveness may accord exactly with what would be expected of an additional testis, and yet the tumor be of an entirely different nature. Even when there is a double penis only two testicles are found.

2. *Anorchism—Unilateral* (*Monorchism*); *Bilateral.*—The congenital absence of one testicle or of both these glands, though rare, has been sufficiently proved by post-mortem examinations. It is usually unilateral (monorchism). The testicle alone may be wanting. More commonly the epididymis and the scrotal part of the vas deferens are also absent. The pelvic portion of the vas and the seminal vesicles are usually present, though cases are recorded showing that even these parts of the genital tract may be wanting. Even though the testicles be present, the epididymis, or vas, or both these structures, may be absent. When the testicles are absent the scrotum is imperfectly developed or altogether wanting.

Bilateral anorchism is characterized by a rudimentary condition of the external genitals, impotence and sterility, and the physical and mental attributes of eunuchism.

The **diagnosis** of anorchism when unilateral is absolutely dependent on post-mortem examination, since a single normal testicle is sufficient to ensure the characteristic attributes of the male sex, and absence of the other testis from the scrotum or the inguinal canal does not exclude the possibility of abdominal retention. Bilateral anorchism would be indicated in early life by rudimentary external genitals and later by eunuchism.

As for **treatment**, on first thought it would seem that the subject of bilateral anorchism is beyond all help. Carrying out a line of modern research to its logical sequence, however, it seems within the bounds of possibility so to modify the course of development that, though potency and fertility cannot be expected, yet the physical and mental characteristics of the male may be preserved. While the removal of either testicles or ovaries in early life usually changes profoundly all the characteristics, physical and mental, of the individual, there is abundant evidence[1] to show that the testicles may lose, or may never have had, the sperm-producing power, and still possess the quality which enables them to hold the organism in its normal groove and to invest it with the other attributes of masculinity. When testes fail to descend, they are incapable of producing spermatozoa, and in consequence the person is sterile. This has been shown by Hunter, Astley Cooper, Curling, Griffiths, and others, and is undoubtedly the rule, although there are occasional exceptions. In spite, however, of the imperfection of the organs, such a person acquires all the external bodily characteristics of the male, and is in all respects, except in the power of procreating, like an ordinary man.[2] It is not known whether this influence is exerted through a chemical product or not, but the fact that some indubitable effects are produced on the whole system by the injection of watery extracts of the testicles would seem to favor this idea. "The function of the testes is, therefore, clearly twofold—viz. (1) to control and determine the development of the characteristics of the male sex, and (2) to produce spermatozoa for the reproduction of the species. These two functions are usually exercised together, but that the former may be exercised when the latter fails seems to indicate that the production of spermatozoa is the more specialized property and attained with more difficulty. In what manner is this sexual effect of the testes upon the body produced? Is it through the medium of the nervous system as an ordinary reflex, or is it through the medium of some substance produced by the seminal cells (whether they form spermatozoa or not) and absorbed into the system, which by influencing the nerve-centres or in some other way controls growth and nutrition? Brown-Séquard tried upon himself, when he was seventy-two years of age, the effect of the subcutaneous injection of a watery extract of the testes of a vigorous dog two or three years of age, and relates that after five daily injections he lost his feebleness, felt many years younger, and was capable of doing more work. The testicle-extract has since been used in various diseased conditions, chiefly those associated with nervous debility, but with only

[1] Curling, 4th ed., p. 14.

[2] Griffiths: *Lancet*, March 30, 1895.

temporary results. During the last few years a watery extract of the thyroid gland has been administered with signal success in myxœdema, in which disease the thyroid gland atrophies and ultimately disappears. The disease myxœdema arises from the want of the influence of some unknown substance—which the thyroid gland, as is supposed, elaborates—upon the nutrition-centres of the central nervous system. It may be that the testis in like manner elaborates, irrespective of its spermatic secretion, some chemical substance which by a similar influence not only controls the growth and development of the body at puberty, but maintains the manly character then acquired throughout life."[1]

It is thus possible that the function of the testicles which relates to the preservation of masculinity (as distinguished from the function of reproduction) may be exerted through a definite substance which has distinct physiological properties of its own, manifested to some extent whenever it is introduced into the system.[2]

If these premises be sound, testicular injections might exert a powerful influence on the general development of bilateral anorchids. These injections, if employed, should of course be administered before the age of puberty (probably the earlier the better), and should be continued certainly for several years. The dosage, the number of repetitions, the period of time over which the treatment should extend, can be at present only discretionary; a trial of this method has never been made. It has merely the merit of being the only treatment thus far proposed.

ANOMALIES IN SIZE.—*Hypertrophy.*—In common with all genital organs the normal testicles vary greatly in size, and without any definite relation to general physical development. Curling states that the fully-matured testis should weigh about six drachms, and that its dimensions should be an inch and three-quarters long, an inch and a quarter wide, and an inch thick. Clinical experience shows that these dimensions are considerably exceeded in many cases in which the testes could not properly be considered hypertrophied. When one testicle is undescended or atrophied a compensating hypertrophy of the other has been frequently noted.

Synorchism, or fusion of the testicles, an extremely rare condition, seems to have been found only in fœtal life.

Arrested Development.—Imperfect development of the testis must be distinguished from atrophy following inflammatory infiltration or neurotic wasting of a fully-developed testis, since the former condition, if bilateral, is accompanied by partial or complete eunuchism. Misplaced testicles are very commonly found to be but partially developed, and even when the transit of the organ is perfect one or both may remain puerile. It is worthy of note that the development of the testis may be delayed for some years beyond the time when it ordinarily attains full size, and that its complete development may shortly follow physiological activity.

The **treatment** of imperfect development of the testes should not be regarded as unavailing. When the testes are undescended, their transplantation to normal position has been followed by rapid increase in size. The stimulating influence of massage regularly administered and long continued should be borne in mind, and the effect which physi-

[1] Griffiths, *Lancet*, March 30, 1895.

[2] *Annals of Surgery*, July, 1895.

ological activity has on growth and nutrition should be considered in advising such patients and in predicting as to their future.

ANOMALIES IN MIGRATION.—The testicle normally passes from near the lower, outer border of the kidney through the inguinal canal into the scrotum. It may be arrested at any stage, may take an aberrant course, or may descend normally, but lie in a faulty position in the scrotum.

Arrest of Passage in the Normal Course.—Abdominal Retention.—Cryptorchism, unilateral or bilateral.—The testicle may be applied to the posterior abdominal wall in close relation to the lower, outer border of the kidney; it may be provided with a long mesorchium, allowing it to move freely in the abdominal cavity, or it may lie in the iliac fossa close to the internal ring.

Inguinal Retention.—The testicle may be arrested at the internal ring, in the inguinal canal, or at the external ring. It is usually extremely mobile until subject to repeated attacks of inflammation, and fixed by adhesion.

Incomplete Scrotal Descent.—The testicle may pass through the external abdominal ring, but fail to descend completely, lying in close relation to the ring or at a varying distance below it.

Aberrant Course of the Testis.—Ectopia.—The testicle, having cleared the outer ring, may pass into the perineum (*perineal ectopy*) or may escape from the abdominal cavity by way of the femoral canal (*femoral ectopy*). The testicle has also been found above the root of the penis.

In *perineal ectopy* the testicle is felt as a freely movable, ovoid tumor, sensitive to pressure, lying on one side of the central raphe, and placed in front of the anus; the cord can be often traced from the tumor to the external abdominal ring. The overlying skin sometimes exhibits rugæ, and the corresponding side of the scrotum is often atrophied.

Femoral ectopy appears as a movable tumor exhibiting the physical characteristics of the testicle and the peculiar sensitiveness. Its position is that of complete femoral hernia or of the inflamnatory swellings which so commonly affect the glands overlying the saphenous opening. Curling observed one case in which the testicle lay behind the saphenous vein three inches below Poupart's ligament, with the cord encircling this vein.

In its bearing on the development and course of hernia and inflammation the relation of misplaced testicle to the peritoneal pouch, which accompanies it, is of great importance. This pouch may remain open, communicating freely with the general peritoneal cavity, and thus enhancing the formation of hernia or the extension of inflammation; it may be closed above this, but open below it, enhancing the development of hydrocele; it may be obliterated. Exceptionally, especially when the testicle is retained, but the epididymis and vas have partly or completely descended, the funicular process of the peritoneum may extend as an open pouch to the bottom of the scrotum, thus allowing a hernia to pass far beyond the position of the retained testis.

Causes of Imperfect Migration of the Testis.—Adhesions incident to pre-natal peritonitis have undoubtedly caused abdominal retention. Curling holds that the inguinal retention is at times due to the small size of the external abdominal ring. Undue shortness of the cord or

any of its integral portions, and the application of a tight-fitting truss before the testicle has descended, are also shown to be causes of non-descent. The irregular development of the gubernaculum would explain femoral, crural, and peno-pubic ectopy. The lower attachments of this muscle are to Poupart's ligament in the inguinal course (Curling), the lower part of the scrotum, and the pubic bone; there are also fibres passing to the region of the saphenous opening. A relative over-development of certain of these bands may draw the testicle into the perineum in front of the pubis, may retain it in the inguinal canal, or may draw it to the saphenous opening.

Misplaced testicles are usually undersized, and in adult life show, on microscopic examination, degeneration and atrophy of the secreting structure. Basing an opinion on these grounds, and upon the fact that spermatozoa are not found in such testes or their efferent ducts, Curling holds that these testes are functionless in so far as reproduction is concerned, and that bilateral retention results in sterility, though not necessarily in impotence. Monod and Arthaud[1] attempt to show, on the other hand, that a retained testicle may secrete healthy semen and show no degenerative changes on section, and that alterations in structure and cessation of spermatogenesis are consequent on repeated or long-continued inflammation, to which the gland is necessarily subject from its faulty position. Certain characteristic changes are produced, beginning in a perivascular infiltration and sclerosis, followed by obliteration and degeneration of the spermatic cells. It would appear from this, that the function of the misplaced testis may be preserved in young men and in those who give no history of repeated inflammatory attacks.

Inguinal retention in the form of incomplete transit is most commonly found; perineal ectopy is the ordinary form of aberrant transit.

The **complications** of misplaced testicle are those incident to the development of hernia into the funicular pouch of peritoneum, to the lighting up of inflammation in the testicle and its adnexa, and to malignant degeneration.

Hernia.—The hernial contents commonly lie directly in contact with the testis and are adherent to it; the funicular form, in which the testicle is shut off from the cord by obliteration, is also frequently encountered; the varieties, complications, and treatment of this condition are fully discussed in another part of this work. It is not amiss, however, to call attention to the extreme gravity of these hernias, since they are especially liable to sudden and complete strangulation.

Inflammation.—The misplaced testicle, and particularly the inguinal form of this malformation, is peculiarly subject to inflammation from traumatism. This inflammation may be so acute that gangrene results, though commonly this complication is due to torsion of the cord.

Traumatic inflammation is usually due to a blow or to a fall or to sudden contraction of the abdominal muscles, pinching the abnormally vulnerable testicle in its already too tight or straitened environment. The attacks are prone to recur suddenly and on slight provocation, and prove completely disabling.

Infection of the posterior urethra, as in the case of gonorrhœa or

[1] *Archiv. gén. de Méd.*, 1887.

catheter-urethritis, may, by passing along the vas, attack the epididymis of a retained testis, and even the gland itself. Finally, it is probable that mumps, typhoid, and other general diseases exhibiting a predilection for the normally-placed testicle, do not spare that which is misplaced, though syphilis and tuberculosis (Jacobson) are not observed in such testes.

The **symptoms** of orchitis, epididymitis, or orchi-epididymitis are much the same as those incident to inflammation attacking the normally-placed organs. There is the same intense, sickening pain radiating to the sacrum and down the thigh, the same exquisite tenderness, the occasional well-marked abdominal reflexes—*i. e.* tenderness, pain, tympany, constipation, and vomiting—exactly simulating the first stage of acute peritonitis.

These local and reflected symptoms bear some proportion to the severity of the inflammation, and are most marked when, from the violence of the original trauma or from strangulation due to twisting of the cord, the testicle becomes gangrenous. Nicoladoni[1] holds that torsion of the cord is peculiarly a complication of inguinal retention, though he records one case of normally-descended testes subject to this accident.

The **diagnosis** is of the utmost importance, since the inflamed testicle commonly not only occupies the position of a strangulated hernia, but may simulate its symptoms exactly.

The history of a movable tumor in the inguinal canal, not entirely reducible, which has been commonly treated with a truss, on the supposition that it is a hernia, and the absence of the testicle from the scrotum of the affected side, are of important diagnostic significance. The inflamed testis is exquisitely tender on percussion, feels solid, or, as there is usually hydrocele, gives an obscure sense of fluctuation. The hydrocele after repeated inflammations becomes chronic. It may be reducible, *i. e.* its sac may communicate with the general peritoneal cavity, and hence it may in this respect still more closely simulate hernia. More commonly the peritoneal communication is closed; the hydrocele as it enlarges may then extend beyond the testis into the scrotum or may mount upward beneath the skin. In cases of gangrene there may be bluish discoloration of the scrotum.

Epididymitis of urethral origin cannot be distinguished from a true orchitis when it attacks an undescended testis, since the symptoms of the two affections are the same, with the exception of the location of swelling, which can be readily found at the back of the testis in a normally-placed organ, but which cannot be thus located when the testis is abnormally placed. The presence of a gonorrhœa or non-specific urethritis should lead to a correct diagnosis in such cases. Exceptionally, as a complication of the testicular inflammation, general peritonitis develops. Curling records one death from this complication. I have seen only one case in many years.

Malignant Degeneration.—The history of malignant involvement of other parts of the body naturally tends to the inference that a retained testis, always poorly developed and subject to repeated traumatisms and inflammations, will be peculiarly prone to malignant degeneration. The

[1] *V. Langenbeck's Archiv*, Bd. xxxi. S. 178.

clinical study of misplaced testicle shows that this is the case. The growth found here is usually a sarcoma or encephaloid carcinoma.

The **symptoms** are the same as those of malignant degeneration of the normally placed testis, except in the location of the tumor. Following or not an attack of acute inflammation, the testicle steadily and rapidly enlarges, becomes irregular in shape, often cystic, painful; and anatomically related glands enlarge; the overlying skin becomes blue, showing dilated veins. When in abdominal retention the testis becomes malignant, the position of the gland makes early detection of the tumor difficult; persistent or constantly recurring pain, steadily growing worse even in spite of rest and treatment appropriate to inflammation, suggests the possible beginning of serious degeneration. Later on the disability, the tumor, the glandular enlargement, and the pressure-symptoms make the diagnosis almost certain.

Treatment of Misplaced Testicle.—In considering the treatment of misplaced testicle it is well carefully to weigh the following facts: 1. A testicle which has not reached its proper position in the scrotum may reach it spontaneously up to the age of puberty; although usually this is not the case. 2. A testicle retained in the abdomen is well protected from traumatism and usually gives little trouble. 3. A testicle which is not in its proper position will not reach full development, though exceptionally it may be functional, secreting healthy spermatozoa. 4. A misplaced testicle is subject to such frequent inflammatory attacks that degeneration or atrophy almost certainly takes place. 5. Such testicles are peculiarly prone to take on a malignant growth. 6. Operation is, so far as life is concerned, not dangerous.

In view of these facts it seems clear that in cases of inguinal or crural retention—high scrotal retention—and in cases of perineal, crural, or pubic ectopy, every effort should be made to replace the testis, and that this end should be attained before repeated inflammations have materially altered the secretory structures.

Inguinal and high scrotal displacement may be sometimes corrected by persistent manipulation of the testis, the cord and its attachments being gradually stretched toward the bottom of the scrotum. When the testis lies close to the external ring or just within the aperture, after pulling it downward, its return to the faulty position may be prevented by application of a truss. Manipulations to be successful must be repeated many times each day, must be so gentle that no inflammation is excited, must be sufficiently vigorous and well directed to stretch slowly and surely the adhesions holding the testis in its abnormal position. They should be begun as soon after birth as possible, and should be continued, unless they give pain or excite inflammation, to the sixth or eighth year, when, if found to be unavailing, or even earlier if there be danger of atrophy from repeated inflammation, a cutting operation is indicated.

Operation for Inguinal Retention.—If the scrotal pouch be developed, the incision should extend from the outer margin of the external ring downward for two inches in the normal course of the cord. It can be enlarged in either direction, if necessary, though it is better to keep the cut small and use retractors. The testicle is often apparently subcutaneous from thinning of the fibres of the external oblique. It and the

cord are examined to determine the condition of the vaginal process of the peritoneum; if this be obliterated, it, together with the adhesions to the tubes and cord, is divided, the cremaster muscle is cut completely through by a circular incision, and the testis is drawn down so that it lies quite free of the outer ring, without retraction. By blunt dissection a way is opened through the subcutaneous cellular tissue to the bottom of the scrotum, which is invaginated through the opening, and secured to the bottom of the epididymis and testis by two or three silk sutures passing through the deeper layers of the scrotal skin and taking a good hold of the tunica albuginea; on letting the scrotal skin fall back to its normal position, the testicle is drawn with it. The external ring is now closed with silk sutures, leaving only enough room for the cord, which is also attached to the columns of the ring by a few fine sutures.

When the vaginal tunic communicates with the abdominal cavity, it is cut across just above the testis, and the distal cut end closed in by a continuous fine catgut suture. The proximal end is then carefully dissected up to the internal ring, where it is ligated. The testicle is then freed and drawn to its proper position. When the scrotal sac is shallow or wanting, the skin incision is made almost vertical directly over the position the scrotum should occupy. After completion of the operation, the wound is sutured at right angles to its original course, thus providing a pouch for the reception of the testis. The difficulty encountered in this operation is not so much dependent on drawing the testis down as it is in keeping it in a normal position. It is to prevent retraction that the cremaster muscle is completely divided, the pillars of the external ring are approximated, and the cord sewed to the pillars. The wound in the case of children should be closed without drainage, and a layer of absorbent gauze should be secured in place by flexible collodion. The patient should be kept in bed for several weeks, and, unless the testis hangs well in the scrotum, should wear a truss for many months.

PERINEAL ECTOPY.—Manipulation and the wearing of an apparatus is, in this form of displacement, quite certain to be unavailing; an operation should be undertaken early, by the fifth or sixth year, since riding on a bicycle or on a horse is necessarily interdicted; even in the ordinary games of boyhood the testicle is liable to be injured. The testicle is, though freely movable, anchored by fibrous bands which require division, after which its replacement in the scrotum is easy. In making the incision, the testicle should be pushed as far forward as possible; in the case of a child an inch and a half incision, placed just anterior to the testicle and exposing the cord, will enable the operator to divide all adhesions, to force a way for the testis into the scrotum, to invaginate the fundus of the pouch through the wound, and to apply a few silk sutures, approximating the base of the testis and the fundus of the scrotum. The wound should be closed without drainage and painted with flexible collodion.

Watson Cheyne[1] has attempted to overcome a difficulty encountered by the majority of surgeons who have operated in inguinal ectopy. He had tried most of the plans suggested, and had in all cases, after freeing the cord and testicle, stitched the latter to the lowest part of the scrotum by means of catgut, and afterward placed catgut sutures in the external

[1] *Brit. Med. Journ.*, Feb. 15, 1890.

ring to prevent the testicles slipping up again into the inguinal canal. The immediate result was, that as soon as the hold on the testicle relaxed, it was retracted to the external ring, drawing the scrotum with it, thus forming a wrinkled edge, with the ultimate result that the testicle lay at, or very little below, the external ring in a position little better than that which it formerly occupied. It struck him that could the tension on the cord be maintained for some days, it would gradually stretch, and when the tension was relaxed the testicle would then remain in its new position in the scrotum.

He constructed a small, triangular wire frame which fitted into the perineum and over the pubes, and was kept in its place by threads of carbolized silk attached to each angle of the frame and passed round the abdomen and thighs. At a point opposite the apex of the scrotum a projecting bar was attached to the frame to which the thread, which passed through the cord, could be tied. The mode of operation in the case which Cheyne reports was as follows: The testicle and cord were freed and brought down into the scrotum, in which a pouch was formed for its reception. A strong catgut stitch was then passed through the structures of the cord immediately above the testicle, and both ends were brought out through a hole at the apex of the scrotum and tied around the projecting bar. Care was taken that the vas deferens should not be on the side of the cord through which the thread might cut its way. In this way any desired amount of tension can be kept up on the cord. In this particular case Cheyne did not stretch the cord at the time of the operation as fully as he intended ultimately to stretch it, but tightened it some days later at the second dressing. After stitching the external ring and the wound, the whole arrangement was enveloped in antiseptic dressings. He did not pass the stitch through the apex of the testicle, but through the cord, to avoid orchitis or the destruction of any of the testicular structure, inasmuch as he thought the stitch would not cut through the cord so quickly as through the testicle.

Of course, it is only in a certain proportion of these cases that any operation with the view of bringing down the testicle can be of benefit, and Cheyne only attempts it in cases where the testicle is fairly movable in the inguinal canal and can be readily made to protrude at the external ring. Where the testicle is retained at the upper part of the inguinal canal, the cord very short, and the testicle much atrophied, he believes it is best, in view of the serious trouble to which it may afterward give rise, to excise it at once and bring together the walls of the inguinal canal.

I have operated by this method in a case of bilateral misplacement, one testicle being in the inguinal canal and one not to be found. The result was at first very satisfactory, but I have heard recently (a year after the operation) that the testicle has been drawn up again to just within the external abdominal ring.

PUBIC AND CRURAL ECTOPY are so rarely found that no opportunity has yet been offered of formulating the best operative procedure. When the testis is placed in front of the pubis at the root of the penis its transplantation into the scrotum should offer few difficulties. In crural ectopy the first effort usually has been to return the testis into the abdominal cavity; failing in this, should the testis give trouble from repeated inflammatory attacks, castration is advised. It would seem

more rational, when the testis cannot be reduced, to dissect it free of its surroundings, clear the cord, divide Poupart's ligament, and transplant the gland to its normal position in the manner described when considering the treatment of inguinal ectopy. Poupart's ligament should be united by suture.

Treatment of the Complications of Ectopy.—*Hernia.*—In certain cases of inguinal retention, complicated by hernia, a properly applied truss keeps up the hernia, keeps down the testis, and promotes obliteration of the patulous peritoneal process. More commonly the truss irritates the testis and does not retain the hernia.

In the latter case, operation is more strongly indicated than when the displacement of the testis is not thus complicated. When the hernia becomes incarcerated or strangulated, operation is still more urgently demanded. When the diagnosis cannot be made between strangulated hernia and orchitis, there should be no hesitation in performing an exploratory operation. Whenever operation is performed on misplaced testis, complicated by hernia, an effort should be made to implant the testis in its normal position and radically to cure the hernia at the same operation.

Inflammation.—Rest in bed, elevation of the pelvis, the application of hot compresses or of an ice-bag, free purgation, local depletion by leeching, and active counter-irritation in the subsiding stages are means of treatment naturally suggested on general surgical principles. The violent pain must be relieved by hypodermic injections of morphia and atropia. The fever and partial suppression of urine are treated by small doses of aconite with sweet spirit of nitre and spirit of Mindererus. The pelvis is elevated by a hard pillow placed under the buttocks.

The choice of hot or cold applications will depend on the wishes of the patient; cold applications are usually the most satisfactory. In mild cases compresses wrung out of lead-water and laudanum and kept wet with the mixture suffice, free evaporation being allowed. When the case is more severe, an ice-bag should be applied, with one thickness of linen between the rubber and the skin. If its weight cause pain, it may be so suspended that it touches, but does not bear on, the surface. The hot-water bag may be used in the same way. If under this treatment and a purge the local symptoms increase in severity, a dozen leeches may be applied about the swelling. If treatment seem utterly unavailing, the general and local symptoms be severe, and particularly if the abdominal reflexes are markedly developed, the possibility of torsion and gangrene or of concealed strangulation of the gut or peritonitis must be recognized, and the question of exploratory operation must be considered. The gangrenous testicle would require immediate removal, while a suppurative orchi-epididymitis of urethral origin might call for equally radical treatment in case the vaginal tunic communicated directly with the abdominal cavity. Epididymitis, however, rarely goes on to abscess-formation, and if it did there would probably be time for the formation of adhesions for the protection of the general peritoneum.

The **treatment** of *malignant growth* is, of course, operation. Ablation should be performed early. Even waiting till the diagnosis is firmly established is not justifiable. A somewhat rapid increase in size without the phenomena of an acute inflammatory attack is sufficient ground for operation. Even though no cancer be found, a useless painful

testis is removed, which may at any time become malignant; if the cancer be removed at this early stage of its development, there is a fair chance that it may not recur.

The difficulties of the operation are not usually great, the tumor remains encapsulated and without firm adhesions to surrounding parts. The tumor should be removed with its capsule and the cord cut as high as possible. Tapping of the attendant hydrocele and emptying of cysts will usually so reduce the bulk of the growth that it readily passes through an incision of moderate size. In cases of abdominal retention a formal cœliotomy must be performed, after which the tumor with its capsule and as much of the cord as possible are freed and removed. Enlargement of the lumbar glands, as shown by swelling of the feet and marked cachexia, should contraindicate operation in these cases.

INVERSION OF THE TESTICLE.—Though the testis reach the fundus of the scrotum, it may still assume a faulty position. Normally, it is tilted slightly forward and outward, with its posterior border and the attached epididymis directed upward, inward, and backward. Any decided departure from this position is termed *inversion*. It may assume almost any position: it may lie on its side, or with what is normally its back presented in front, and it may be turned completely upside down, which is termed *reversion*. *Anterior inversion* is the common form of abnormal position; the epididymis and the corresponding border of the testis are turned to the front. In this case the tunica vaginalis by its distention below and behind the testis forces this gland into the position usually selected for driving in the trocar; hence the importance in tapping for hydrocele or cutting for hæmatocele of remembering that this malposition is comparatively frequent. Hence, again, the necessity of careful palpation, of the test of translucency, and, when the position of the testis cannot be determined by these methods, of either opening the sac by careful dissection or of driving in the trocar at the side of the scrotum, as advised by Monod and Terrillon.

Edmund Owen has reported[1] an interesting case of axial rotation of the testis in a school-boy, sixteen years of age, who had an undescended testicle on the left side. A swelling suddenly appeared while he was bowling at cricket. He was admitted to the hospital two days afterward as a case of strangulated hernia. Just outside the left external abdominal ring there was a tender swelling of about the size of a small hen's egg. There was no impulse in it; the skin over it was not discolored. The boy was in considerable distress. On gently dragging the tumor downward it was found that the spermatic cord and the external abdominal ring were free and clear; the tumor could not therefore be a hernia. As there was no history of injury, it was not likely that the swelling was either a hæmatocele or an inflamed testis, but probably a testicle engorged as the result of axial rotation of the cord. On cutting down to it, however—which was done at once—the cord above the tumor seemed to be neither twisted nor congested. The distended tunica vaginalis was then opened, and a good deal of blood-stained serum escaped. At the back of the cavity there was the swollen testicle, which had the appearance, though not the odor, of gangrene. The cord was tied and the testicle removed; it was then noticed that the

[1] *Trans. of the Med. Soc. of London*, vol. xvii.

upper part of the tunica vaginalis still contained fluid, and was shut off by an oblique groove from the rest of the serous cavity, which was now wide open and empty. Further investigation showed that this groove lay exactly over a sharp and sudden outward half-rotation of the cord. As soon as this twist was unfolded the upper cyst of the tunica vaginalis emptied itself into the lower, the blood-stained fluid escaping as the two parts of the sac once more became continuous. The upper part of the tunica vaginalis had no communication with any funicular process; there was no sign of hernia, but, as often happens in a case of an undescended testis, the tunica vaginalis was extremely capacious, extending well above the epididymis, and as the half-turn of the cord was immediately at the top of the epididymis, it happened that the tunica vaginalis was itself caught in the twist, a small part of the serous cavity being thus nipped off and isolated. It was this upper distended sac which had hidden the twist of the cord until the testis had been removed. Judging from the readiness with which the swollen mass allowed itself to be lifted out from its bed, it was thought that it possessed no mesorchium. The boy returned home cured in less than a fortnight.

Mr. Owen gives a résumé of 13 more cases, and remarks that the right side was involved in 8 instances and the left in 5. More important than this, however, is the fact that the twist is generally associated with imperfect descent of the testis, and not seldom with a congenital hernia. He doubts whether a satisfactory explanation of the cause of the rotation of the testis will be forthcoming, though various theories may be advanced. The theory of misdirected energy of the gubernaculum is not altogether acceptable, for, even if the gubernaculum has all the power ascribed to it, it is difficult to see how, being fixed at its lower end, it can swing the testis round and round; and, as the rotation has sometimes occurred when the patient has been lying in bed, violent effort cannot be always the cause of the disaster. Boys about sixteen years of age are, or should be, almost always at violent exercise, and it is at least suggestive that it is only an undescended testicle which assumes this very peculiar position. There is one thing quite certain—namely, that a testis which possesses a normal mesorchium in the scrotum cannot be twisted. A scrotal testis with a long mesorchium may possibly undergo rotation, but this accident is far more likely to affect an undescended testis which has no mesorchium in the proper sense of the term. The direction of the twist taken by the revolving testis is entirely a matter of chance.

In many instances of axial rotation of the testis it must be impossible for the surgeon to make the diagnosis before cutting down upon the swelling; but there need be no difficulty in making a correct diagnosis when the rotation has taken place so near to the testis that the external abdominal ring may be found to be empty, the cord unobscured, and the vas deferens of normal size; when there is no history of kick or blow, and no discoloration of the skin; and, on the other hand, when there is a history of imperfect descent of the gland; when the epididymis is found in front of the testis; or when that half of the scrotum is empty. In every case, however, the diagnosis is best confirmed by exposing the swelling, unless, indeed, the cord may be untwisted, as was done by Mr. Nash in the following case: A youth, nineteen years of age,

after a bout at boxing and a period of rest, experienced a pain in his right testicle, and, as is usual in these cases, vomited. Mr. Nash saw him within two hours, and found the testicle and the epididymis to be swollen and tender. They were in the normal scrotal situation, but the epididymis was anterior, and, as he could make out a tender knob or kink in the cord, he rightly diagnosed an axial rotation of the testis. Without a cutting operation he promptly and smartly rotated the testicle inward, leaving the epididymis posterior. At once pain ceased, the swelling began to subside, and the patient was relieved.

Owen concludes his paper as follows: "As regards treatment, the tunica vaginalis being opened, the tense, plum-colored gland being exposed, and the twist in the cord being detected, what should the surgeon do? The answer which I would give is, 'Let him tie the cord high up and remove the swollen mass.' And for these reasons: If, as is probably the case, the testis has never completed its descent, it is more than likely that it is of no physiological value; but even if it be perfectly developed, the chances are that the terrible engorgement to which it has been suddenly subjected would entail its subsequent atrophy, even if the gland escaped actual suppuration or gangrene. Twisting the spermatic cord in the lower animals is the French method of producing atrophy of the testes and sterility, and surely no other result can be expected after a tight twist of the cord in the human subject. Mr. Bryant is probably correct in his surmise that certain cases of atrophied testicle have been examples of axial rotation, the nature of which had been originally overlooked. Seeing, therefore, that disappointment is almost inevitable in these cases if an attempt is made to save the gland after operating, that the risks of sloughing and septicæmia are not inconsiderable, and that, on the other hand, rapid recovery follows ablation of the darkened mass, there can be little advanced (except the sentimental reason) in favor of leaving the gland. The points to which it may be well that future observers should specially direct attention in cases of axial rotation appear to me to be these: (1) The relative position of the testis and epididymis; (2) the antecedent development and the extent of the descent of the testis; (3) the association of a congenital hernia or of an open funicular process; and (4) the exact nature of the mesorchium, and, in the event of the testis being replaced, the subsequent progress of the case and the ultimate condition of the testis."

LUXATION OF THE TESTES.—Acquired displacement of the testis may be due, first, to sudden violent contraction of the cremaster excited to reflex action either by trauma or by muscular strain or without apparent cause, or, secondly, to direct violence so applied as to drive the testicle out of the scrotum.

Displacement from muscular contraction is the more frequent variety of luxation. The testis may be fixed in the groin external to the ring; in the inguinal canal; or may be retracted into the abdominal cavity. It is generally found in the inguinal canal, where it may be permanently fixed by inflammatory adhesions. Such displaced testes are subject to the accidents already discussed when treating of congenitally misplaced testes.

Luxation from direct violence is extremely rare, and can occur only from the application of very considerable force. Whether displacement

of the testicle be congenital or acquired, repeated disabling inflammations and atrophy are almost certain to follow; hence, restoration of the testis to its normal position is always to be attempted. This is sometimes possible by manipulation. This failing, the necessary operative measures should be adopted; the testis freed from adhesions, the cremaster muscle completely divided (when this has been the cause of the displacement), and the gland sutured to the bottom of the scrotal sac.

WOUNDS OF THE TESTICLE.—Incised wounds of a healthy testis, if limited in extent, heal readily even though not subject to antiseptic treatment. Arteaga[1] has shown that extensive incisions, opening the albuginea the whole length of the testis, heal readily, but are followed by atrophy similar to that observed as a sequel to contusion. When an inflamed testicle is cut, or when, subsequent to the incision, the gland becomes inflamed, increased intraglandular pressure, incident to congestion and proliferation, may cause extrusion of the seminiferous tubules, and a part or even all of them may escape through the opening.

Lacerated and contused wounds are usually inflicted by bullets. They heal readily, but are often followed by atrophy.

Punctured wounds—such, for instance, as those inflicted by a trocar in the operation for tapping a hydrocele—show little or no inflammatory reaction, providing the gland be healthy. When the trocar is not clean or when the testicle is previously diseased, the puncture may excite an acute orchitis which may result in complete atrophy.

The treatment of wounds of the testis is conducted on general surgical principles. When the tunica albuginea is incised, after thorough cleansing, the opening should be completely closed by suture.

Lacerated and contused wounds demand the thorough removal of all devitalized parts and the covering of the testis by suture of the scrotum, provided the injury be seen sufficiently early to ensure an aseptic condition of the parts; otherwise, drainage by means of gauze should be adopted.

Punctured wounds should be treated by elevation and the application of cold in the reactionary period, and by incision and drainage on the first signs of pus-formation. In the dressing of all these wounds the "crossed-of-the-perineum" will accomplish pressure and elevation.

INFLAMMATION OF THE TESTICLE.—By far the most common form is epididymo-orchitis, known as gonorrhœal epididymitis (*q. v.*). In this case there is usually some extension to the testicle and some vaginalitis, shown by the presence of acute hydrocele, which often makes up the bulk of the swelling. The same condition may be produced (according to Monod and Terrillon, and Jacobson) by gout as a sequel to a posterior urethritis associated with enlarged prostate. The latter author says:[2] "This form of epididymo-orchitis is not common, but is of great importance from the age and position of the patients amongst whom it occurs and the liability of the urethritis to be overlooked. In gouty urethritis the following points will aid the diagnosis: The scalding or smarting is complained of in the deeper urethra, rather than near the meatus; the discharge is not usually very profuse, and, being mucopurulent, is whitish rather than yellow. The patient is very liable to

[1] "Plaies du Testicule," *Thèse de Paris*, 1883.
[2] *Diseases of the Male Organs of Generation*, p. 250.

lithiasis; the urine is habitually very acid and loaded with uric acid or urates; dry, scaly eczema is often present; and perhaps tophi and worn-down teeth. The patient has very likely been living too well, drinking rich wines, etc., or in some other way evoking into activity a latent gouty taint."

Anything, which either mechanically (lithotomy wounds, impacted calculi) or chemically (over-strong injections or irrigations) brings about a solution of continuity of the mucous membrane of the deep urethra, may be a sufficient cause of epididymitis. Much discussion as to the essential etiology of the disease has occurred, but it is now well established that it is an ordinary infectious inflammation, reaching the testicle by continuous extension from the orifices of the ejaculatory ducts along the vas deferens.

The **symptoms**, whatever the cause, do not differ materially from those to be described in the section on Urethritis.

The results vary. In the great majority of cases, the inflammation disappears by resolution; sometimes it runs on to suppuration, either in the vas, in which case the pus may be discharged *per urethram*, or in the epididymis itself. I have never seen the latter complication as a result of gonorrhœal epididymitis, but, in a number of instances, have been called to see cases in which it had occurred during the catheter-life of aged persons with enlarged prostates. In a few instances I have known it to be followed by general sloughing of the testicle.

It is probable that these cases of testicular abscess and gangrene differ from the ordinary cases that disappear by resolution, only in the resistant powers of the tissues. The same micro-organisms, introduced on instruments, or finding their way into the vas from the urethra, are the infecting agents in either case. The importance of this fact seems to be scarcely realized even yet in its practical bearings by many surgeons. In a case where old strictures were being dilated and two days after the passage of catheters an acute epididymitis occurred, followed by suppuration, Mr. Jacobson says, in summarizing it, that the case "is of interest on account of the apparent absence of septic causes (a point always to be thought of with regard to catheters), and also from the fact that no discharge was visible. . . . . The catheters were new ones, and between the time they were passed and the onset of orchitis there had been no urethral discharge." This ignores the obvious possibility that "new" catheters not properly sterilized might well convey infection, and the equally obvious fact that in cases of old stricture, even without urethral "discharge," the infecting agents, almost never absent from even healthy urethras, are certain to be present. The most important lesson to be taught in regard to all forms of suppurative disease, following urethral instrumentation, is that by proper preparation of the patient locally and generally, and by careful sterilization of the instruments, nine-tenths of these diseases are avoided.

The hard nodule which is left in the globus minor after a case of epididymitis I have never known to disappear entirely. I have examined many patients at intervals of five, ten, or fifteen years, after having treated them for the acute affection, and have been invariably able to recognize easily the testicle which had been the seat of the inflammation. No treatment for this is required; none is of the least use.

It is fortunate that no obvious changes in the testicle result from this condition. It probably renders the individual sterile as far as that single gland is concerned, but it does not attract his attention nor arouse his anxiety, and therefore is not the cause of sexual hypochondriasis and neurasthenia, as it otherwise would be in a large number of cases. This observed absence of testicular change as a result of the blocking of the epididymis or the vas is in accord with the latest evidence upon the subject. In seven experiments upon dogs in which I tied, or divided, the vas the resulting changes in the testicle were unimportant.[1]

Curling[2] discusses at length the effects upon the testes of deficiencies or imperfections of the vas deferens. He shows from observations of Hunter (1775), Cooper (1823), himself (1842), Gosselin (1853), Godard (1857), and others, that the vas may be obliterated or may become so from injury or disease without interfering, as a rule, with the development, or the apparent health, of the testicle. He says: "The engorgement of the seminal ducts with sperm is liable, it is true, to cause inflammation of the testicle, which may end in atrophy, but this is only a secondary, and indeed a rare, effect of the interruption in the excretory duct."

Griffiths[3] has recently confirmed these observations by experiments upon young dogs. He details the results in four cases, and sums up as follows: "Accordingly, when the vas deferens is ligatured in puppies there is no immediate result either upon the epididymis or testicle, nor is the growth of the latter in any way interfered with; that is to say, the ligature of the duct does neither hasten nor retard the growth of the gland, and the testicle acquires its maturity both of structure and function just as if the duct had been left alone in its natural and previous state. Again, when the vas deferens is ligatured in full-grown dogs there occurs enlargement of the epididymis, with tenderness. This enlargement in part subsides, leaving it, together with the portion of the duct up to the seat of ligature, permanently enlarged from the accumulation of semen. The structure of the seminal tubules remains unaltered, and they are, after a few days, or a few months, just the same, showing the active formation of spermatozoa, like those of the normal testis, the duct of which is left natural and undisturbed; therefore ligature of the vas deferens induces a slight enlargement of the epididymis and of the vas deferens up to the seat of ligature, but it does not interfere in any way with the structure of the seminal tubules or the production of spermatozoa."

Treatment.—The treatment of all forms of acute epididymitis is to be conducted on the lines laid down in regard to the gonorrhœal variety. (See *post.*) In the gouty form the usual antilithæmic remedies should be administered and the diet and hygiene carefully looked after. Suppuration should be treated by early incision, irrigation and packing. Even when the abscess seems extensive the testicle may often be preserved. If sloughing has taken place, it is well to perform castration without delay. The remains of the testicle will be useless at the best, and will probably cause the obstinate persistence of suppurating sinuses.

ORCHITIS AS A COMPLICATION OF ACUTE INFECTIOUS DISEASES.—The type of this form of orchitis is that due to *mumps*, and it is also the

[1] *Annals of Surgery*, p. 47, July, 1895. [2] *Diseases of the Testis*, ch. i. section ii.
[3] *Lancet*, April 13, 1895.

oldest and the most fully described in surgical literature. It is commonly a genuine orchitis, occurring at any age, but, on account of the fact that mumps is a disease of childhood and adolescence, is usually seen in young persons, developing as a rule at about the end of the first week of parotitis, preceded often by a slight rigor and moderate rise of temperature.

The **symptoms** are those of an ordinary case of orchitis or epididymo-orchitis, already described. (See *supra*.) This variety is characterized by the rapidity of its course. The degree of swelling, intensity of pain, and severity of constitutional phenomena are all moderate.

The widespread belief that this form of orchitis is often followed by testicular atrophy is, in my opinion, well founded. I have seen several cases of withered testicles which clearly resulted from the orchitis of mumps, and I have heard of many more from general practitioners of undoubted acumen and judgment. Jacobson says that he believes the occurrence to be very rarely met with in Great Britain or in America.[1] Of course, as mumps is now almost universally treated here, with special precautions as to the prophylaxis of orchitis, as it is not itself a very frequent disease, and as only a small minority of the cases suffer from this complication, and only a minority of them from atrophy, it is in a sense a rarity. But I venture to assert that an appeal through the medical journals for the experience of the profession in this direction would result in large numbers of cases being published.

The most interesting point in regard to it is the **etiology**, the nature of the association which causes the transference. Although I do not agree with his conclusions, I know of no better discussion of this subject than that given by Mr. Jacobson, which is as follows: "The connection between the orchitis and the parotitis has usually been described as metastatic—*i. e.* the inflammation leaves one organ to attack another, the transference occurring usually to the testis, much more rarely to other parts, *e. g.* the ovaries or the meninges of the brain. Against this view, which has too much been taken for certain, the following points may be urged. As pointed out by M. Rilliet, it is not a true metastasis; the parotitis, though lessening, is still present usually when the orchitis appears; and no case has been recorded in which the orchitis suddenly disappeared and the parotitis reappeared. Again, why, when it is the salivary glands that are inflamed, should the inflammation be especially transferred to glands so widely remote in position and so different in structure as the testes? As the disease is one of puberty and early adolescence, if the breasts were first affected the transference to the testis, considering the tenderness and enlargement of the breast and testis often present at puberty, would be intelligible; but no such sequence is constant, the breasts often escaping altogether. As I pointed out in 1882,[2] it is much more probable that the inflammations of the salivary glands, the testis, etc. are different localized manifestations of one pyrexial condition, probably due to a special organism. The following seems to support this view: While the specific organism to which mumps is due cannot be said to have been definitely discovered, it is only a question of time before bacteriologists put the origin of the disease on the same firm foundation as they have done with so many other diseases. Thus,

[1] *Op. cit.*, p. 280.

[2] *Syst. of Surg.*, vol. iii. p. 517.

MM. Cafitan and Chavin found in the blood of patients with mumps organisms which they were able to cultivate. Absolute confirmation is, however, wanting, as the experimental inoculation of cultures failed.

"The different localized manifestations, of which the orchitis is one, may occur quite independently of each other. In some cases, it is the orchitis which comes first, occurring epidemically, and followed after a while (*e. g.* after a period of one to five days—Crevissier d'Hurbache, Lynch, Berard, Rizet) by parotitis, the order usually described being thus reversed. Orchitis may even constitute the whole malady, the 'orchite ourlienne sans parotidite' of French writers. Kovacs gives two such cases.[1] On other occasions, the two affections have occurred simultaneously.[2] Again, during epidemics of mumps, individuals who have shown no trace of swelling of the salivary glands have been attacked by orchitis.[3] Thus, Ressynier gives a case in which a young man became the subject of orchitis without any parotid affection. This occurred at Montpellier in an epidemic in which orchitis was very prevalent. One most interesting case is recorded by Bluff,[4] in which a man, whose wife was suffering from parotitis, was attacked with double orchitis. Another case, in which the testis was attacked, without any parotitis being present, is recorded[5] by a medical man who does not give his name. It is not only interesting from the patient having orchitis alone, but also on account of his age. A man aged fifty-two, married, and free from any urethral discharge, was suddenly seized with swelling of the right testis and epididymis. Two of his sons were found ill at the same time with well-marked parotitis. The patient had never had any swelling of the face, and had been quite well up to the same day as that on which one of his sons had been taken ill. When he was seen three days later there was no swelling of the parotid.

"Finally, it is well known that other complications, *e. g.* meningitis, wrongly termed metastatic, are not uncommon in mumps. In some of these cases meningitis and orchitis coexist.[6] In these patients, a boy aged fifteen and a man aged thirty-five, the symptoms, *e. g.* headache, excitement, and delirium, were extremely severe.[7] In others the orchitis sets in as the meningitis is subsiding.

"All the above appear to me to point to the fact that mumps is an infective disease, which may show itself by divers manifestations localized in different parts of the body. Why the testis is so often attacked is not far to seek when the age of most of the patients and the coexistent activity of the sexual organs are remembered.

"Kocher, rejecting the theory of metastasis as being unintelligible, since, 'according to the old interpretation, the inflammation leaves one organ to go to another, like an unclean spirit,' explains the connection between orchitis and parotitis as follows: 'Orchitis after mumps is, according to him, an urethral orchitis, in which the inflammation extends from the urethral mucous membrane to the testis along the vas deferens.' Kocher thus traces the inflammation: 'Beginning as a stomatitis,

[1] *Wien. klin. Woch.*, 1890, Bd. xxi.
[2] Ressynier, *Méd.-chir. Rev.*, vol. vii. p. 204; Kocher, *Krank. d. Hoden*, Bd. iii. S. 239.
[3] Boyer Montpellier: *Journ. de Méd.*, Mai, 1867, p. 239; Kocher: *loc. supra cit.*, S. 238.
[4] *Gräfe u. Walthier's Journ.*, Bd. xxi. [5] *Lancet*, 1885, vol. ii. p. 189.
[6] *Ibid.*, 1883, vol. ii. p. 280; 1890, vol. ii. p. 1156.
[7] *Brit. Med. Journ.*, 1881, vol. i. p. 966.

the inflammation soon reaches the salivary glands. It then travels along the pharynx to the intestinal tract, and thence, after few days, by means of blood-infection, a slight cystitis is set up, from which springs secondarily, the inflammation of the testis.' Kocher likens the above affection of mucous membranes to erysipelas. In this he comes very near to what I believe the correct view of the origin of this orchitis, but I cannot at all agree with his statement that the affection of the testis is a urethral orchitis—*i. e.* correctly speaking, an epididymo-orchitis. It is the substance of the testis itself, and not the epididymis, which is usually, and in all cases primarily, affected. Furthermore, we have no evidence of the existence of any cystitis."

Jacobson's view, thus ably set forth, does not explain the fact that the complication occurs in adults who have mumps and in whom there is no special "coexistent activity of the sexual organs." I have myself seen it developed in a married man aged thirty-five, and I have seen several women of ages ranging from twenty-two to forty who had the analogous ovaritis, or at least the characteristic ovarian pains and tenderness which indicated its existence.

Orchitis after small-pox, scarlatina, influenza, and typhoid has no pathognomonic features. The cause in each of these cases is probably the localization of the micro-organism causing the general disease, or possibly its conveyance to the testicle by means of a phlebitis, especially of the spermatic veins.

Malarial orchitis is often of a chronic type, having intermissions in severity, but associated with a slow increase in the size and hardness of the gland. Le Dentu (quoted by Jacobson) thus describes it as "elephantiasic hypertrophy" of the testicles. "The coincidence and clinical identity of elephantiasic hypertrophy of the testicles with elephantiasis of the scrotum prove, without doubt, that they have a common origin from a similar lesion. Whatever be the cause of the elephantiasis, it is the lymphatic system which is primarily affected. It is a reticular lymphangitis, coming on in attacks of erysipelatous appearance until the day when chronic œdema and hyperplasia of the connective tissues show the presence of elephantiasis." M. Le Dentu considers that there is a striking resemblance between these attacks and those which characterize many cases of malarial orchitis. He inclines to the opinion that the latter is often an intra-testicular lymphangitis, a repetition, and that elephantiasis of the testicles thus produced is really a chronic lymphangitis which may succeed the acute form or commence more insidiously.

Orchitis in relation to tonsillitis has been especially studied by Joal,[1] who details seven cases in which the relation of attacks of quinsy to orchitis was very similar to that between mumps and the same disease. Jacobson approves of Joal's theory of causation, which is similar to the one in regard to mumps which he has adopted. The latter states that acute tonsillitis is a specific infectious disease, and explains why the tonsils, testicles, and ovaries are especially singled out by the fact that the disease occurs when these organs are at the maximum of their physiological activity. I cannot avoid the feeling that, as in the case of mumps, the facts are rather forced to fit the theory, which does not seem to me to explain satisfactorily many of the clinical phenomena.

[1] *Archives générales de méd.*, March, 1886.

Gouty orchitis is often associated with the usual phenomena of gout, and is then unmistakable. It may be very acute, but is more often of a chronic type and very persistent; sometimes, however, it alternates with other gouty symptoms, disappearing with the onset of an arthritis and reappearing as the latter subsides. I have known patients to be wrongly suspected of having had an infectious urethritis, and Sir James Paget has given an account of a case which is interesting as an example of the care which should be exercised in the investigation of such patients. I quote Jacobson's abstract of the case: "A gentleman had acute orchitis, attended with all the usual signs, local and general. No history of injury, no sign of renal calculus nor of having passed any through the bladder and irritated the urethra, nor of inflammation of the prostate or urethra, could be made out, and it became necessary to look for some general or constitutional cause. The patient said he had never had any illness in his life, but mentioned that he had lately been annoyed with a pain in his heel which did not lay him up, and that not infrequently on awaking in the morning he felt pains darting through his knuckle, and sometimes his fingers and toes felt rather stiff. Also he frequently had cramps during the night in the muscles of the calf and elsewhere; he had suffered, too, a good deal from indigestion attended with flatulence, and lastly he had been troubled with painful erections, which often disturbed him two or three times in the night."

Sir J. Paget goes on to remark that though not one of these five or six symptoms would be enough, if taken alone, to prove anything, yet their coincidence or quick succession was quite sufficient to show that the patient had a gouty constitution. Gouty orchitis is very prone to relapse, and is thus very tedious; it occurs in very sudden seizures, and not rarely it is transferred by metastasis from one testicle to the other.

Traumatic orchitis, as compared with the epididymo-orchitis of infectious diseases, is rare, owing to the firm support the gland receives from the tunica albuginea and to the free movement of the testicle, not only within its serous tunic, but also within the scrotum, and, on the other hand, to the fact that septic organisms gaining access to the ejaculatory duct, or brought to the gland in the general circulation, are in either case arrested and given the opportunity to multiply in the neighborhood of the epididymis. We thus have a sufficient explanation of the greater frequency of the latter disease. Many patients who suffer from injuries to the testes, and who have as a result large effusions of blood and a marked degree of acute inflammation, recover with no appreciable permanent change in the organ. When suppuration occurs the pyogenic organisms gain access to the injured tissues either by way of the vas or through the general blood-channels. There can be no doubt that a true, acute, orchitis may develop, though rarely, without either injury or infection to account for it. In 1872, on reaching a port in South America after a long sea-voyage, a sailor on a vessel to which I was attached went ashore "on liberty." He got drunk in a bar-room on the wharf, and never left it until he was put out late at night. He sat in a puddle of water for some hours, and was found then in alcoholic stupor, and brought back to the ship early in the morning. He had not been ashore before for weeks, and had no form of venereal disease, acute or chronic.

He developed a typical acute orchitis, which, however, subsided with rather unusual rapidity.

CONTUSION.—When sudden, strong, direct pressure is applied to the testis, and the gland is caught against the perineum or the pubis, injury to its secreting substance must follow. This commonly results from the saddle in riding, from a kick, a blow, a stroke with a ball, a fall astride, a wrench, or squeeze with the hand. Considering how frequently trauma in the forms first mentioned is applied to the scrotum, it is surprising that severe contusion of the testicle is not more common.

There is a form of injury not properly to be classed as contusion, which in itself occasions no lesions and is followed by no sequelæ, and is so frequent that probably every adult male has experienced it many times; this is, a jarring of the testicle, such, for instance, as comes from the blow of a slow tennis-ball. This causes pain which, though exceedingly severe, is transitory, passing off in a few minutes, and leaving a soreness which lasts at most for a few days. When such slight injuries are followed by well-marked inflammatory signs, commonly, it will be found that this inflammation is in reality due to gonorrhœal or tubercular epididymitis.

Monod and Terrillon,[1] who have experimentally investigated contusions of the testicle, recognize three degrees of this injury. The first is characterized by minute, disseminated capillary hemorrhages into the connective tissue lying between the seminal tubules; these hemorrhages are also noted in the connective tissues binding together the convolutions of the epididymis, and from the inner surface of the latter the epithelium is exfoliated in places. The second degree of contusion is characterized by larger hemorrhagic effusions, reaching the size of a pea, or cherry-stone, and by laceration of the tubules. Large blood-effusions are never found. The third degree of contusion is characterized by rupture of the proper tunic. This is properly a crushing of the gland, and is characterized by free bleeding, which, escaping through the rent of the albuginea, distends the cavity of the tunica vaginalis, producing an acute traumatic hæmatocele.

The **symptoms** of contusion of the testicle are: severe, sickening pain, often accompanied by nausea and vomiting; shock, very exceptionally so pronounced that death is almost instantaneous; and, shortly, swelling, exquisite tenderness, and, because of concomitant bruising of the scrotum, discoloration. The first unbearable anguish is of comparatively brief duration; this is succeeded by a severe, sickening pain, made worse on standing, coughing, or straining; this pain persists till local reactionary phenomena have reached their height, and is so severe that anodynes are required for its relief. Locally there is a rapid swelling, participated in by the epididymis, but due in great part to effusion into the vaginal tunic and to œdema of the loose cellular tissue of the scrotum. The reactionary congestion may become converted into a true inflammation, pus forming in the testes or epididymis, usually because of a pre-existing latent tuberculosis of the parts, or, very exceptionally, the pus-formation is dependent on the ordinary pyogenic micro-organisms which find in the injured testes a focus of lessened resistance.

The symptoms in this case do not subside. The swelling steadily

[1] *Archiv. gén. de méd.*, Paris, 1881.

increases, an area of fluctuation is detected, and finally the abscess bursts or is opened. The constitutional symptoms of pus-formation are well marked. Rarely, the abscess, if small, may become encysted and absorbed; it usually opens spontaneously or is incised, and, if originating from the testicular parenchyma, may discharge, together with pus, the seminiferous tubules and at times the whole gland.

The congestion-phenomena may disappear entirely, and be followed by no sequel, the effused blood and the plastic exudate incident to reaction entirely disappearing and the parts returning to their normal condition. In this case the symptoms grow less severe in two or three days, the swelling rapidly subsides, and there are no subsequent changes in the contour of the testes.

The usual termination of a severe contusion is atrophy, organization of the intertubular exudate, and cicatricial contraction, producing obliteration of the secreting structure of the gland. This atrophy may follow apparently trivial bruises; it is most apt to occur during youth. The epididymis is usually spared. The atrophic process may be progressive and uninterrupted, the pain and swelling of the traumatism disappearing, the testicle regaining its normal size, then continuing slowly to shrink. Occasionally, the reactionary phenomena do not subside absolutely, the testicle remaining enlarged and presenting the characteristics of a chronically inflamed gland. The pain and swelling ultimately subside, to be succeeded by atrophy. Exceptionally, there are repeated mild congestive attacks, characterized by pain and sudden swelling, the testicle growing rapidly smaller between these attacks. The atrophic process may affect merely a portion of the testis, producing only moderate diminution in size, but marked deformity. More commonly, the whole gland is involved, there remaining when the process is completed a soft body of varying shape the size of a lima bean or even much smaller. The epididymis is commonly not involved in this process, preserving about its normal size. Exceptionally, it too is wasted.

Prognosis.—Even when injury to the testis apparently has been slight, if there follows what are called inflammatory phenomena—*i. e.* marked swelling, persistent tenderness, and severe continued pain—there is strong probability that atrophy will follow, particularly if the patient injured is a child or youth. When the injury is more severe and subsequent symptoms of acute congestion are more marked, atrophy is almost certain to occur. When sufficient violence has been exerted to rupture the albuginea, wasting of the testis is certain. General well-advanced atrophy of the testis completely destroys the spermato-genetic power of the organ.

Treatment.—This should be directed to limiting the amount of blood-effusion and to lessening the severity of the reactionary phenomena, thus lessening the amount of cell-proliferation and exudate. Syncope and severe shock are treated on general principles, the severe pain being controlled by hypodermics of morphia. The patient should be placed on his back with the hips elevated, and the scrotum held up either by a pillow placed close to the perineum or by a handkerchief bandage, the base of which is passed beneath the scrotum, the ends being secured to a band around the waist. To the injured testis may be applied cloths kept constantly wet in lead-water and laudanum, not covered with oiled

silk, thus encouraging evaporation. Better than this for the first three days is a small ice-bag. In case cold is uncomfortable, hot compresses wrung out of lead-water and laudanum and frequently renewed (every fifteen minutes) may be employed. The bowels should be freely opened, and when the swelling and pain are unusually well marked leeches may be applied along the cord in the inguinal region. When the active symptoms have disappeared, a properly fitted suspensory bandage should be worn, and the patient should be especially cautioned against riding horseback, bicycling, or taking any form of exercise liable to occasion repeated slight trauma.

Orchi-epididymitis from strain is properly considered in relation to contusion of the testis, since in a certain proportion of these cases the symptoms of the affection are undoubtedly due to bruising or pinching of the testis. As to the mechanism by which such inflammation is produced, there is a diversity of opinion; thus by some it is held that it is due to pressure upon the vas deferens; others hold that it is due to pressure upon the veins of the cord; and still others that the injury is inflicted by violent contraction of the cremaster muscle, which by suddenly jerking the testicle against the pillars of the external ring, causes a bruising of the latter, often accompanied by a rupture of the veins. This is called by the French the *coup de fouet*, or whip-snap action.

According to Roux, the theory of compression of the cord and its veins is made probable by the existence of certain fibres which pass from the rectus muscle to the inner lip of the iliac crest. When the abdominal muscles are thrown into sudden violent contraction, these fibres participate in the motion, and in pressing the cord upward pinch it against the fibrous circumference of the external abdominal ring.

The general consensus of opinion, however—and this is particularly the case with recent writers—strongly inclines to the theory that the cremaster muscle alone is the direct cause of the inflammation.

That this muscle is capable of very vigorous contraction cannot be doubted. Thus it is not rarely observed that direct trauma of the testicle is followed by marked retraction of the organ, so that it may be drawn into the inguinal canal or even into the abdominal cavity. Even in severe pain, such as that which accompanies renal colic, the testicles are frequently found in close apposition to the external ring, while any one can observe the contraction of the cremaster by noticing the motion of one or both testicles during the passage of a catheter. Certain cases of chorea of the testicle are at times observed when this organ is moved by the cremaster with considerable rapidity and violence.

Richet, while acknowledging the important rôle played by the cremaster, believes that the result of this contraction is due, in the main, to rupture of the veins produced by pressure upon them. The majority of writers strongly favor the "whip-snap" action of the cremaster, and the consequent bruising of the epididymis and testicle as the cause of the subsequent inflammation.

Upon the "whip-snap" theory alone it is hard to explain why the affection should exert such a decided predilection for the left side. Of Englisch's 7 cases, in 6 the left testicle and epididymis were involved; the seventh was bilateral.

There is, however, a theory, the rationale of which is much more readily comprehended, and which would account for the appearances observed in at least the great majority of the reported cases.

The spermatic plexus of veins is peculiarly under the influence of intra-abdominal pressure; the vessels are provided with but few and imperfect valves, are feebly supported by the surrounding tissues, and hence are especially subject to disease. Thus varicosity of these veins is one of the most common surgical affections, and the effect of the contraction of the abdominal parietes and the diaphragm upon these dilated veins is so marked that succussion, or coughing, or straining, in any way, is sufficiently distinct to simulate that of an omental hernia. Given, then, a sudden and violent increase of pressure in these vessels, it is perfectly possible to conceive that rupture may take place, even though they be healthy; this is of course more probable if they are weakened and dilated. Such a rupture would naturally take place in the cord, in the epididymis, or even in the substance of the testicle. And, if the theory of venous rupture from pressure be correct, we should expect the left testicle to be more frequently involved, as the veins of this side are more frequently varicose, and we should expect the pain to be slight at first and gradually increase as more blood was effused and inflammatory symptoms developed.

These are the very conditions which characterize orchi-epididymitis following muscular effort, and from them we have sufficient explanation of its occurrence in many cases, without ascribing any portion of the cause to cremasteric contraction, although as a factor the latter may be subsidiary or in a certain proportion of cases it may be even the chief factor.

Experimentally, it is found that the violence of traumatic orchitis and epididymitis is directly proportionate to the amount of injury inflicted, and that where the trauma is at all severe there is nearly always extravasation of blood, not only beneath the fibrous tunic of the testicle and epididymis, but into the parenchyma of these organs, particularly of the epididymis. It is also observed that the inflammatory symptoms following direct violence do not always immediately appear.

In the form of orchitis and epididymitis under discussion it would seem that much the same lesions occur as when the organs affected are bruised by external violence. That there is frequently extravasation of blood can be confirmed by examination. The inflammatory symptoms are marked, but come on slowly. Often they are not disabling, the patient being able to attend to his business, though suffering from a constant dull pain and dragging sensation.

The **prognosis** is much better than is that of contusion of the testis from external violence. When the lesion is simply a hemorrhage into the lower part of the cord or into the epididymis, with but slight congestion of the testis, subsequent atrophy of this organ is not to be feared. It is rare that the lesions affect chiefly the testis; in these cases subsequent wasting may follow.

The **treatment** is that appropriate to traumatic orchitis.

TUBERCULAR DISEASE OF THE TESTIS.—The infecting organism may gain access to the gland after having first set up disease in the kidneys or in the bladder or prostate. As a rule, however, uro-genital

tuberculosis begins in the epididymis. Occasionally the testicles, and then the epididymis, are affected during the evolution of a general miliary tuberculosis. The fact that the spermatic artery divides at the epididymis may account for the localization of the disease in the latter organ; the slowing of blood-current always favors bacterial growth. The direct channel offered by the vas deferens is another, and probably equally important factor, in determining the localization of the disease. Verneuil has strongly defended the theory of direct infection during coitus. The uterine discharges during tuberculosis of that organ have been shown to contain bacilli, and thus to be competent sources of infection. To the objection that in this event the urethra and bladder would be primarily affected, the answer is that the physical conditions—*i. e.* a slow-moving current of viscid fluid rather than a frequent flushing with a watery one—favor fixation and propagation of the organism in the vas (and its extension to the epididymis) rather than in the urinary channels. The process is compared to what occurs in inhalation-tuberculosis, "in which the disease manifests itself, not in the mucous membrane of the bronchial tubes, but in the parenchyma of the lung-apices." Réclus opposes the theory of direct infection. Jacobson considers the question an open one, but adds that if the theory were correct, tubercular diseases of the sexual organs would be more common than they are; which does not seem to be correct. Tubercular disease is undoubtedly far more frequent than was supposed until quite recently. As each year increases our knowledge of the uro-genital forms of tuberculosis, a constantly increasing number of cases of testicular disease fall within that category. They were classed in old times with malignant diseases or with syphilis, or assigned to some minor traumatism, or thought to be instances of ordinary suppuration and abscess. They certainly do not seem to be so infrequent as to weaken materially the theory of possible direct infection. It is, of course, certain that many men, exposed to this danger, escape, just as many escape infection with the gonococcus or with the virus of syphilis, while others after intercourse with the same woman are infected.

The practical importance of the subject is evident. I believe that the facts before us justify, first, a careful examination of uterine and vaginal discharges for bacilli in suspected cases; and next, when bacilli are found, in giving equally careful directions as to prophylaxis.

The general **predisposing causes**—namely, inherited soil, diminished local resistant power from traumatism, precedent or coexistent inflammation, habitual congestion, etc., are the same as for tubercular disease in any locality.

The disease begins either in the head, or less frequently in the tail, of the epididymis; later the testicle itself, and later still the tunics, are invaded. The vas is very commonly involved.

Symptoms.—As a rule, the symptoms that first attract the attention of the patient are very similar to those of a gonorrhœal epididymitis, but careful inquiry will often elicit the fact that previous to the acute pain, swelling, and tenderness, there existed one or several nodules in the epididymis; almost always there has been a slight urethral discharge, probably mistaken for one of venereal origin or for a gleet. There will generally be at this time some coincident swelling of the

ostate or of the seminal vesicle on the affected side. The disease in the more acute form will rapidly run on to the formation of numerous foci of caseation and softening, and of sinuses communicating with the surface of the scrotum.

In the more chronic cases the tubercular disease will be usually discovered during the stage of proliferation in the epididymis, where the small painless nodules will be found, which generally increase until they involve the entire body of that organ, and finally the testicle itself.

The ultimate results are the same—viz. caseation, softening, discharge by multiple sinuses.

Diagnosis.—The urethral discharge and the urine in doubtful cases should be carefully examined. The presence of gonococci should not exclude tuberculosis, as we have seen that an antecedent or coexistent inflammation is a distinct predisposing cause. The discovery of the bacillus tuberculosis would, however, practically establish the diagnosis. It is by no means to be found, however, in every case; possibly not in the majority. The course of the case as above described will usually render its recognition easy in the later stages.

The **prognosis** is affected by two factors—the amount and virulence of the bacilli and the character of the soil in which they grow. These can be determined only by the course of the case, which will be unfavorable in a direct ratio to (*a*) the rapidity of development; (*b*) the extent of involvement of the gland; (*c*) the tendency to become bilateral. In any event, it cannot be too strongly emphasized that, as in all other forms of uro-genital tuberculosis, the ultimate result is almost certain to be fatal if the patient is entrusted to the *vis medicatrix naturæ*.

After a fairly broad and constantly increasing experience with this disease, I can warmly endorse the views of Mr. Jacobson as to this important point. He says:[1] "I have expressed my opinion decisively on this most important matter. I have tried to show that there is too great a tendency to trust to medical means here; that one of two opinions is much too often given with regard to these cases: one, that there is good hope that the mischief, if left to itself, will undergo a process of natural cure by atrophy and more or less suppurative destruction of the parts involved; the other, that nothing can be done, for whatever course is taken there is no possibility of eradicating the disease. With regard to the first of these opinions, I have tried to show its danger and to inculcate that at the present day, with our knowledge of the course which tubercle, if left to itself, runs here as elsewhere, and with the means now at our command, there should be no dallying with such a belief for a moment. With regard to the second opinion, that the disease is necessarily a fatal one and admits of no active treatment, I hope I have put the case fairly. I would in no way make light of the fact that tuberculosis of the epididymis and testicle is too often merely the local expression of a general outbreak in the genito-urinary organs. But I maintain that in a large number of cases this outbreak does not take place all at once—that it starts in the epididymis, and only reaches the other parts later because it is too often allowed to do so. If all the male sexual organs, epididymis, testicle, vesiculæ seminales, and prostate, were supplied by arterial offsets given off at the same points, the bacilli would

[1] *Op. cit.*, p. 358.

reach them all at the same time, and the outbreak of the mischief would be not only general, but simultaneous. But that this is notoriously not the case anatomical data teach us, and in many cases anatomy is here supported by clinical results. Until we despair of these cases we should at least put ourselves in a position to show that we have done our best to eradicate at the earliest possible moment the primary lesion while it is localized and readily attacked.

"With regard to the other cases in which the tuberculosis of the epididymis and testicle is clearly secondary, or certainly coexists with lesions in the prostate and vesiculæ seminales, we are not, of necessity, to hold our hands. Where the mischief here is of early date, where it is running a slow course, we may still hope to benefit the patient by a timely castration, which by removing a useless and damaged organ will improve his general condition and defer the evil day which very likely must come.

"I have said before that the occasional encapsuling and partial cretification of caseous deposits in the epididymis must not be looked upon as a sign that the disease is now quiescent, at an end, or no longer a cause for anxiety."

Treatment.—*Medical* treatment consists in the employment of all the hygienic measures adapted to tuberculous patients generally, and in the administration of the drugs most likely to be of use in the same class of cases, especially cod-liver oil, syrup of the iodide of iron, compound syrup of the hypophosphites, and preparations of cinchona.

Surgical treatment in cases of strictly localized disease—*i. e.* of very small separate nodules or foci of caseation—may consist in thorough excision, following by vigorous scraping and packing with iodoform. In the more advanced cases nothing is worth considering except castration, and this should be advised unhesitatingly when the disease is unilateral. When both testicles are affected the risk of the disease on the one hand, and on the other the lessened probability of a radical cure, together with the disadvantages of emasculation, must be laid fairly before the patient. If he acquiesces, castration is again the method of choice as offering the only possible chance of cure.

The particular indications for it are thus formulated by Jacobson: "(1) Where the treatment by erasion fails in lesions still limited to the epididymis. If one or more discharging fistulæ still persist here, especially if the patient is not in a position to avail himself of a repetition of the operation at the seaside, castration should be performed, slight as the mischief seems to be. It is only too probable that small deposits are already making their way into the testicle itself by spreading along the rete—a condition extremely difficult to make out by external examination. (2) Where after erasion the fistula or fistulæ have healed, but careful watching of the patient, which must always be insisted upon, detects the existence of, it may be, slight but persistent swelling, with night-sweats and loss of flesh. These may point to mischief connected with the remains of the sexual gland, and not, necessarily, to that in the prostate, etc. or in the lungs. (3) When the body of the testicle is involved. When this remains enlarged, irregular in outline, and liable to attacks of subacute inflammation, tenderness, and pain, castration should be performed. If a medical man encourages a patient with sev-

eral nodules in the testicle or epididymis to leave these untreated, there is always a grave risk that these, which are already potential sources of mischief, will be lit up into fresh activity, eventually fatal, by some trifling injury or pyrexial attack. (4) Where the testicle remains small and atrophied, and riddled with fistulæ, one or more of which persist in discharging, removal of a useless and dangerous organ should always be practised. (5) Where a hydrocele is present, especially if purulent. Even in cases where a hydrocele, coexisting with tubercular disease of the epididymis or testicle, resembles an ordinary hydrocele closely in its naked-eye characters, the presence of bacilli must be carefully excluded both by the microscope and inoculation-tests before the fluid can be pronounced to be innocent."

For the operation of castration see p. 681.

SYPHILIS OF THE TESTICLE.—Syphilis may affect either the epididymis or the testicle itself; the former is usually an early, the latter a late, manifestation. I have elsewhere[1] considered this subject, and shall summarize the views there expressed: Toward the termination of the secondary lesions of syphilis, a period varying from four months to a year after the beginning of the chancre, there is occasionally observed upon the epididymis a limited induration, generally at its head. The small tumor, varying in size from a bean to a walnut or larger, is connected to the testicle, is hard, indolent, and may easily be overlooked. More rarely it is situated upon the body of the epididymis, and the spermatic cord has been seen swollen. It is either unilateral or bilateral. There is no accompanying affection of the tunica vaginalis or of the skin. The tumor very soon disappears under treatment by mercury and iodide of potassium.

The nature of these gummata is determined not only by the previous history of the patient, but also from the fact that they have not followed a gonorrhœa and that they promptly disappear under specific treatment.

This form of epididymitis was first described by Dron many years ago. It may be recognized by its association with early syphilitic symptoms, by its comparative indolence and painlessness, its situation in the globus major instead of the globus minor, and its rapid disappearance under constitutional treatment. It should not be confounded with the little fibromata which occasionally occur in this region.

Bassereau, Rollet, Lancereaux, and Fournier have reported cases. It is very rare for the affection to spread beyond the globus major, although in a few instances it has involved the whole epididymis.

Hill has seen two cases in which it appeared at the first outbreak of the cutaneous symptoms and before the primary sore had healed, but usually it occurs about three and a half months after infection. In the later stages the epididymis is affected only when the testicle itself is diseased. Greenfield reports one case in which at an autopsy a small gumma was found in the epididymis, but does not give any details. The case is presumably the only one of the sort thus far recorded.

Interstitial Orchitis.—Interstitial orchitis of the adult in acquired syphilis belongs, like gummous orchitis, to the period of the later tertiary lesions. It seldom occurs before the third year. It is unilateral or bilateral. The testicle is the seat of an inflammatory thickening of all

[1] *Cornil on Syphilis*, Simes and White.

its connective tissue—a chronic interstitial inflammation. The epididymis is seldom affected; if it be involved, it is its head that is changed.

At the beginning of interstitial orchitis the gland is larger than normal, its oval shape is retained, and the enlargement is not very marked. If the disease be permitted to take a natural course, the gland gradually atrophies, still remaining indurated. There is frequently a notable effusion into the tunica vaginalis, which is inflamed.

When a syphilitic testicle has been removed by the surgeon or when it is examined after death, there is seen an inflammation of the visceral layer of the tunica vaginalis, together with thickening or roughness due to small indurated projections which involve the tunica albuginea. A section of the testicle through its long axis shows the fibrous partitions which run from the body of Highmore thickened and dense. The entire organ is more indurated than normal. The seminal tubes cannot be drawn out, as in a healthy gland, on account of their attachment to the new-formed connective tissue. The cut surface is gray or pink at the beginning of the disease; later, when the testicle is atrophied, it has a fibrous appearance.

Section of the tunica albuginea shows the membrane to be irregularly thickened, measuring from one to five millimetres. Its very dense tissue passes into the projecting granulations upon its surface. The fibrous trabeculæ which traverse the gland have also undergone the same change.

The distribution of the interstitial inflammation in the parenchyma of the testicle is not uniform; there are seen points of fibrous tissue in the regions where the inflammation is most intense.

Wigglesworth says as to this disease: "The sarcocele of the French school may be a thickening of the tunica albuginea, with the formation of new fibrous tissue between the seminiferous tubules, which gradually causes the absorption of these last and takes their place. This is the sclerous sarcocele of Fournier, the interstitial orchitis of Cornil and Ranvier, the diffuse orchitis of Lancereaux, or the syphilitic albuginitis of Ricord. It is the most common manifestation of syphilis in the testicle, and causes atrophy of this organ unless arrested by treatment. The other form is the gumma proper, a plastic product accompanied by thickening of the tunica albuginea and hyperplasia of the fibrous septa. The gumma may be circumscribed and of the size of a walnut, or may infiltrate the testicular tissue, spreading along the septa. Reynier makes a distinction between superficial gummata, suppurating speedily, causing ulceration, and yielding to the treatment so that the intact seminiferous substance may regain its functions, and deep gummata, generally parenchymatous, rarely suppurating, of slow progress, possibly causing fungous masses when opening exteriorly, and yielding to treatment after the testicle has been reduced to a shell and its functions destroyed. Fungoid formation does not necessarily follow suppuration."

The **symptoms** of interstitial orchitis are insidious; the patient does not always observe them at the beginning; there is not any local suffering, but only a dull pain in the lumbar region, and this is sometimes absent. The disease may begin in one or both testicles at the same time; after having affected one it may later invade the other.

The skin of the scrotum is normal; one or both of the testicles are increased in size; a tumor is observed which is often due to a slight

effusion into the tunica vaginalis with the hypertrophy of the gland. The epididymis is seldom swollen. Ricord formerly believed that the epididymis and cord were never implicated, but later observations have shown that both these parts of the spermatic passage may at times present nodules of considerable size.

Upon careful palpation of the testicle there may be noticed the elastic resistance of the tunica albuginea, the thickening, the unevenness, the small, hard granulations upon the surface of the organ—all peculiarities which are valuable aids to diagnosis. These physical signs vary, according to the age of the lesion, while the gland is enlarging; in a few years an incurable fibrous atrophy follows, and as a consequence the function of the testicle is lost; there is no formation of spermatozoa and impotency results. The latter is to be distinguished from sterility. Fournier maintained that patients who have the testicles indurated and completely atrophied from an interstitial orchitis may still have sexual connection. This, however, does not agree with the general opinion, which is that syphilitic orchitis destroys the capability of erection.

Diagnosis.—The affection in question must be distinguished from tubercular orchitis and from malignant disease of the testicle. The latter, whether carcinomatous (of the soft variety) or sarcomatous, usually has areas of differing density, runs a rapid course, attains a large size, involves the skin frequently, and is associated with involvement of the iliac and lumbar glands, in all these points differing from syphilitic orchitis.

Tubercular orchitis begins in the epididymis, undergoes the characteristic caseous softening, is often painful, and is usually associated with tubercular disease of the prostate and seminal vesicles, and for that reason, with a urethral discharge; the presence of bacilli in the discharges would be diagnostic. In addition, a history exclusively syphilitic or tubercular would be of much aid; the therapeutic test is often decisive.

The treatment should be that appropriate to the constitutional disease. I have learned to have faith in the local use of mercurials, and would strongly advise, in addition to the internal administration of full doses of potassium iodide and mercurials, the employment of a mercurial salve, of such strength as can be well borne by the scrotum, kept continuously applied.

Tumors of the Testicle.

Bland Sutton says that the infrequency of tumors of the testicle stands in striking contrast to the frequency with which they occur in the ovary. Their varieties, however, bear an inverse relation to their frequency. For practical purposes they may be divided as follows:

Carcinoma . .	Soft, medullary—spheroidal-celled.
	Hard, scirrhus—(?)
Sarcoma . . .	Soft round-celled.
	Hard spindle-celled.
Mixed tumors	Enchondroma.
	Cystoma.

Myxoma.
Fibroma.
Myoma.

The pathology of these various growths is of extreme interest in its clinical relations, but need not be discussed here. The malignant and mixed tumors are the only ones of much practical importance, and about them there are infinite differences of opinion.

Sutton remarks: "Malignant tumors of the testis require careful investigation, conducted on a full supply of material, accompanied by careful clinical histories." This is undoubtedly true. Some writers make elaborate classifications which include a large number of varieties and subvarieties. Others, as Butlin, regarding the matter from the operative standpoint, consider the differences between the chief forms of malignant disease to be so inconsiderable that they need not be taken into account in the question of operation. Jacobson discusses the clinical history of carcinoma and that of sarcoma together. Even the methods of extension of the two diseases are exceptionally similar, sarcoma here involving the nearest glands with greater frequency than when it is situated in any other part of the body, with the possible exception of the tonsils. There are a few points of difference worth noting. Carcinoma occurs chiefly in men between thirty and forty-five years of age. It is almost never seen in children before the age of ten. Sarcoma is frequently seen in young children, and with almost equal frequency at middle age. Sarcomata are often intermingled with cartilage, carcinomata never. Sarcomata of the round-celled variety are sometimes bilateral; this is never the case with carcinomata. With these exceptions the ordinary course of the two forms of growth may be described as follows:

MALIGNANT DISEASE OF THE TESTICLE.—**Symptoms and Course.**—Whatever the form of the growth, there is exceedingly apt to be a history of a previous blow or squeeze, or less frequently of some infective inflammation, gonorrhœal or syphilitic. The same doubt exists in regard to the exact relation of traumatism to malignant disease here as prevails in regard to growths in other regions or organs—*e. g.* the breast.

Williams[1] says: "Those who maintain that cancers are caused by traumata must explain how it is that men, who suffer nearly three times as often from traumata as women, are nevertheless only about half as liable to cancers." And he adds, further, "that intrinsic causes are much more important factors in the origination of cancer than extrinsic ones, which are by no means its necessary antecedents. In the vast majority of cases the outbreak of this disease appears to be entirely spontaneous; that is to say, it cannot be attributed to the immediate action of any appreciable extrinsic cause whatever." But the evidence of direct relationship in the case of the testicle is stronger than in most other regions, and has led Rindfleisch to say that "the glandular and other organs of generation are generally far more prone than other parts to exhibit a transition of simple inflammatory irritations, of ulcers, operation-wounds, catarrhal overgrowths (hyperplasiæ) into sarcomatous, and ultimately into cancerous, degenerations. The longer a formative process persists at any point in the generative system—as, *e. g.*, the external os—the more marked does the tendency toward luxuriant prolification, and finally to carcinosis, become." Jacobson makes several

[1] *Diseases of the Breast*, p. 295.

allusions to this statement in support of his own views as to the etiology of testicular growths.

The age at which the growths appear has already been mentioned. The beginning is usually insidious. Pain in the early stages is absent. The tubules in the centre of the gland near the rete testis are apt to be primarily involved. The swelling is for some time confined and outlined by the tunica albuginea, and therefore has an ovoid shape and a smooth surface, which do not at first suggest malignancy. After the limits of the tunic have been transcended and irregular bosses and nodulations appear on the surface of the organ, the diagnosis becomes easier, but in the mean time much valuable time has been lost. In all forms of malignancy extension to the iliac and lumbar glands and generalization of the disease are comparatively early phenomena. The local swelling increases with rapidity. It is rare for the surgeon to be in doubt for a longer period than a few weeks, even if the case is seen early. The skin becomes adherent and involved sooner in the carcinomatous than in the sarcomatous growths, but in either case, if operation is delayed, will give way under pressure. Before this the cord will usually have become thickened and enlarged, and this occurs so constantly that it becomes a valuable diagnostic sign. If it enlarges *very* early in the disease, however, it indicates inflammatory changes in the testicle, and rather argues against the existence of a neoplasm. If the growth be a spindle-celled sarcoma, the phenomena above noted will cover a longer period of time in their development, but little increase in size being noted for several months. But it is always liable to change suddenly in this respect, and, owing to escape from pressure of overlying structures, to an accidental trauma, or to some more recondite cause, to take on a rapidity of growth and extension characteristic of the utmost malignancy.

The final stage is as to its general features that of all malignant diseases—emaciation, anemia, adynamia, and all the signs of profound cachexia—with, in this instance, pain, tenderness, and other abdominal symptoms superadded on account of the involvement of the pelvic glands.

Diagnosis.—The differences between malignant disease and tubercular and syphilitic orchitis have already been considered.

Hæmatocele is the condition most likely to be mistaken for malignant disease. There should be, however, either a history of trauma with a growth developing in a time measured by hours or perhaps minutes, or a history of an old hydrocele (into the sac of which a hemorrhage may have occurred). Pain is an early symptom; the cord is not affected; the swelling does not enlarge continuously; it is less bossy and irregular than the later stages of malignant disease; testicular sensation is not so completely lost. Tapping will usually be conclusive, although Moullin states that he was on one occasion deceived by tapping a blood-cyst in the centre of a sarcoma.

Hydrocele, when old, with a thickened sac, containing much fibro-cartilaginous material, opaque, and with a hard and more or less uneven surface, may closely resemble the denser and more indolent forms of malignant disease. In such a case exploratory incision without delay is

advisable, followed by packing to cure the hydrocele or by castration in case of malignancy.

Prognosis.—This is more favorable as to duration of life the more dense and more solid the tumor. Without operation the disease always results fatally. Operation is successful, as in other forms of malignant disease, in inverse proportion to the age of the growth. The results should be more than usually favorable if the ease with which all the diseased structures can be removed (prior to the involvement of the cord) be alone considered. This is counterbalanced by the tendency to exceptionally early glandular involvement.

On the whole, the operative prognosis is well summed up by Mr. Butlin[1] as follows: "Castration for malignant disease is an operation which may be performed with very small danger to life. The operation, whether for sarcoma or carcinoma, cannot be said to be attended with large success, so far as complete cure of the patient is concerned, but there is a great lack of information on this subject. There is, however, evidence to show that it may be attended with permanent success, and there is still further evidence to show that the operation may be an excellent palliative measure even if it fails in its primary object—cure. There is comparatively little fear of recurrence *in situ* unless the cord is thickened or the scrotum adherent at the time of the castration. There is no prospect of success for operations for recurrent disease unless the recurrence is seated in the scrotum. Castration may be performed for malignant disease of both testes—if not with a reasonable prospect of permanent, yet certainly of temporary, relief. Castration may be performed with the hope of temporary relief in cases of malignant disease in children."

Treatment.—No treatment is worth considering except early castration (*q. v.*).

Enchondroma testis may be (1) simple or (2) mixed.

(1) Simple enchondroma is rare, and it seems likely that as these growths are more carefully studied it will be found still less frequently. The growth usually follows an injury and takes place slowly, remaining for long periods limited by the tunica albuginea, and consequently preserving a globular or ovoid shape. It may persist about the size of a walnut for from six months to two or three years. The epididymis and the cord are uninvolved for a long time, the latter occasionally remaining intact until the testicular growth attains a considerable size. Pain is not marked. In the latter stages the swelling shows bosses and is irregularly lobulated, but it is usually of uniform consistency, the density being greater than in most other new growths of the testicle.

(2) Mixed enchondroma—that in which the connective tissue between the cartilaginous masses is replaced by sarcomatous tissue—has the same general characteristics, but runs a more rapid course, attains a larger size, is more apt to present areas of varying density and to involve the cord earlier.

Both forms of enchondroma take their origin, as has been shown by Virchow, in the interstitial connective tissue in the rete testis.

Symptoms.—Monod and Terrillon (quoted by Jacobson) divide these into three stages: (1) The first, not very well defined, in which the tes-

[1] *The Operative Surgery of Malignant Disease*, p. 293.

ticle is somewhat enlarged, but without any definite characteristics. The duration of this stage varies from four to six months to two and a half to five years. (2) The second stage. It is now that the patient usually comes under observation. The swelling, the more the cartilage predominates, tends to be oval, of remarkable firmness and hardness, its outline smooth and uniform at first, becoming later irregular, with bosses or nodules of lowly elevated outline. The swelling is usually indolent and free from pain, the dragging weight being all that is complained of. (3) In the third stage the growth becomes generalized. While this stage must always be remembered, it is not constant, occurring only in the "mixed" and more malignant chondro-sarcomata, and in a certain number, the proportion being as yet unexplained, of the purer enchondromata.

Treatment.—In every form of enchondroma castration should be performed the moment the diagnosis is reasonably assured. The most innocent have malignant tendencies, while others are as truly malignant as cancer.

Cystoma Testis.—Here also we have two groups: (1) Simple cystoma (or cystic fibroma), in which the intercystic tissue or stroma is simple fibrous tissue; (2) Mixed cystoma (cystic sarcoma or cystic disease of the testicle), in which, together with the formation of cysts, there is also the development of sarcomatous elements in the structure of the growth.

Both forms probably originate, as Curling long ago showed,[1] in the ducts of the rete testis.

Symptoms.—The simple form is of slow growth, usually attains but moderate size, has a smooth surface, retains the ovoid shape for a long period, has a feeling of elasticity or of pseudo-fluctuation, does not involve the cord or the iliac or lumbar glands, and has no effect on the general health. It is a disease of middle life. The mixed cystomata grow more rapidly and to a larger size, present more irregularities of surface and of density, and oftener involve the cord and bring about generalization of the disease, cachexia, and death.

Treatment.—It is obvious that the diagnosis between the two forms is a matter of difficulty, and that the grave dangers involved in a continuance of either variety of the growth should lead to prompt castration whenever the surgeon is satisfied as to the general nature of the disease.

Microscopic examination of the growth, if it demonstrates the absence of sarcomatous elements, may be followed by favorable prognosis as to return, but even this should be guarded.

Fibroma, *myxoma*, and *myoma* are surgical rarities which need not be described here in detail. The treatises of Monod and Terrillon and of Jacobson mention altogether less than a dozen cases as recorded in surgical literature. I have never seen a case of either of the two latter.

In 1882, I removed what proved to be a true fibroma from the testicle of a young man. It was closely attached to the tunica albuginea, but was not incorporated with the body of the testicle itself. I was able to enucleate it. Such a growth should perhaps not be called

[1] *Op. cit.*, p. 382.

a fibroma of the testicle, but should be regarded as bearing the same relation to that gland that a tumor of the dura mater does to the brain.

Castration.—With strict attention to antiseptic details castration is a remarkably safe and simple operation. The careful preparation of the patient is therefore of great importance. The pubes and scrotum should be well cleansed, the part being covered with an antiseptic dressing until the time of operation, when the washing should be repeated.

The incision will vary with the conditions present. Where the tumor is small and not adherent to the skin of the scrotum, an incision beginning one inch below the external abdominal ring and extending to the bottom of the scrotum is often used; a smaller one meets the requirements equally well. If the tumor, on the other hand, is large, the skin adherent, or a number of sinuses are present, two elliptical incisions should be so planned as to include the diseased surface. The incision should be made layer by layer, as this enables the operator to judge of the amount of involvement and to decide on the extent of interference required. In some cases it is necessary to remove the tunica vaginalis, as when it is involved in the growth, and sometimes it is necessary to incise it for diagnostic purposes. Where it is not requisite to remove the tunica vaginalis and there are no adhesions, the testis can usually be shelled out or torn out by the fingers. In both cases, after the first incision has been made, the fingers alone should be used except where adhesions are found to be too strong.

Up to this time there will be little bleeding, which should be controlled by hæmostatic forceps. The testicle, now freed from its surroundings, is drawn well down, while a finger passed up along the cord determines its condition and acts as a director to open up the inguinal canal as far as may be necessary. The cord is then isolated, firmly grasped, and made tense. A silk ligature may be thrown around it, and the section of the cord made about a half inch below it. The stump should be lightly cauterized with pure carbolic acid. If it is preferred to ligate the vascular constituents of the cord separately, three arteries (the cremasteric, the spermatic, and the deferential) must be tied. The deferential artery is found close to the vas, and with it a few veins. The cremasteric lies to the outside of the cord near its surface. The spermatic artery is in front of the vas deferens, surrounded by the pampiniform plexus of veins, and can scarcely be distinguished from them. Each artery should have a separate ligature, while the two sets of veins may be tied *en masse*. Control over the cord in case of hemorrhage should be maintained till the end of the operation by artery forceps fastened to the stump of the cord.

All bleeding from the scrotal tissues is now controlled, either by the forcep-pressure or by ligatures, any very redundant portion of the scrotum having been removed. The edges of the wound are carefully approximated, especial care being taken to prevent inversion by the dartos. Close coaptation can be secured by placing blunt hooks in the extremities of the wound and exerting gentle traction. The sutures should be silkworm gut carefully applied; the last one may secure in place in the lower angle of the wound a drainage-tube if the case is an infected one.

Usually drainage is not necessary. An antiseptic dressing is then applied and held in place by the "crossed-of-the-perineum."

Retention of urine may be present during the first day after operation. The stitches are to be removed on the fifth to the seventh day; if primary union is not present, it may be necessary to bring the edges of the wound together by strapping. As the wound heals the cicatrix becomes depressed from the obliteration of the scrotal pouch.

Complications.—The presence of a hernia either reducible or incarcerated complicates the operation. A careful examination of the patient before operation should prevent any serious accident; the hernia, if reducible, should be carefully held up by an assistant, or, if irreducible, should be left alone until the castration is accomplished. The opportunity should then be taken to perform a radical cure by any of the well-known methods. This is easily accomplished when the hernia is reducible; in the other form, if there are no contraindications, the sac should be opened, the adhesions broken up, and the radical operation performed.

HÆMATOCELE.—Jacobson thus classifies hæmatocele: (1) Hæmatocele of the tunica vaginalis; (2) encysted hæmatocele of the testis; (3) hæmatocele in the substance of the testicle; (4) hæmatocele of the epididymis; (5) combined abdominal and scrotal hæmatocele—bilocular hæmatocele; (6) hæmatocele of the cord.

Hæmatocele of the tunica vaginalis, the usual form of hæmatocele, is, as compared to hydrocele, extremely rare. As a result of punctured wounds or of rupture of the testis from violence it may appear as an acute blood-effusion into a previously healthy tunica vaginalis; commonly it develops in a previously inflamed sac, often as a complication of hydrocele.

The **cause** of hæmatocele is traumatism: this need not be severe; often the increased blood-pressure incident to violent muscular strain is sufficient to cause rupture of the newly-formed blood-vessels supplying a thickened and inflamed vaginal tunic. Monod and Terrillon hold that except in the acute traumatic variety of the affection this inflammation of the vaginal tunic is a condition essential to the development of hæmatocele, and that the blood-effusion is simply a symptom of such inflammation; hence they term the condition chronic hemorrhagic vaginalitis. The vaginalitis is generally regarded as secondary to disease of the epididymis or testis.

The walls of a chronic hæmatocele are dense and thick, partly from a fibroid alteration of the vaginal tunic, partly from the formation of false membrane. The false membrane is often laminated, and most abundantly deposited on the vaginal surface lying in contact with the scrotal skin. At times an incision of an inch in depth is required before the fluid contents of the hæmatocele are reached. In such cases many hemorrhagic foci are found; these are sometimes appreciable as nodules on palpation of the tumor.

Gosselin recognizes three degrees of hæmatocele, basing his classification upon the extent of alteration which the walls of the sac show. The first degree is characterized by moderate thickening; the vaginal tunic is but little altered beyond some increase in vascularity; there is a deposit of thin, non-adherent false membrane; on evacuation of its contents the

sac can collapse. The second degree is characterized by increased thickness of both the vaginal tunic and the false membrane. The walls are too rigid to collapse on evacuation of the contents of the sac. The condition is progressive. The third degree is characterized by still greater thickening and rigidity. Areas of cartilaginous and calcareous transformation are observed.

The false membrane is made up of inflammatory exudate from the inner surface of the vaginal tunic; it is poorly supplied with blood-vessels, and hence prone to slough; in old cases it is so intimately connected with the proper tunic that its stripping from the latter is often impossible.

The Contents of Hæmatocele.—Blood more or less altered, or blood mingled with the fluid of hydrocele, is found in the sac of a hæmatocele. In old cases the blood is altered both in color and consistence; it may form a chocolate-colored or black syrupy, or even a gelatinous, mass. When the bleeding is into the sac of a hydrocele the fluid is clear red, containing clots.

The testicle in recent cases, and in those not attended by much thickening, is not materially altered, even though the blood-accumulation be very large. As the walls of the sac become indurated a similar change takes place in the albuginea, and fibrous trabeculæ are given off from this, resulting in atrophy of the tubules and fatty degeneration of their epithelial lining. In the cases corresponding to Gosselin's third degree careful search may fail to find even a trace of the testis.

The gland usually occupies the same relative position to hæmatocele as it does to hydrocele; that is, it lies in the posterior lower part of the tumor. It may lie to the front, in which case it would almost certainly be wounded were the possibility of this position not considered before operation. Its location by the test of translucency is of course not possible; palpation will, however, usually elicit the peculiar testicular sensibility, thus showing the position of the gland. When there is general hyperæsthesia of the whole tumor, this method of location is not serviceable. In such cases the incision should be made with extreme care, permitting the surgeon to recognize the testis before it is injured, should it lie in the line of opening.

Symptomatology.—In acute traumatic hæmatocele the symptoms are pronounced and immediate. Following trauma or severe muscular strain there is rapid formation of a slightly painful, pyriform, non-translucent tumor, showing at first thrill and fluctuation, and attended by scrotal ecchymosis. This tumor gradually becomes more solid. When the hæmatocele is of slower formation, it may steadily increase in size, or after intervals of quiescence there may be short periods of rapid growth.

When hæmatocele follows tapping of a hydrocele, the bloody tinge given to the fluid and the subsequent acute swelling, discoloration of the scrotum, and return of the tumor to its original size, with the loss of transparency, will establish a diagnosis. The hæmatocele of slow formation presents a painless, hard, ovoid or pyriform tumor with smooth or bosselated surface, showing at times spots of softening. When the testis is atrophied, or deeply imbedded in false membrane or laminated clots it may be impossible to determine its position. The history of the case shows that the growth has formed very slowly, that it has not

begun to develop till middle age, and that it has been subject to periods of sudden rapid growth with slight inflammatory phenomena.

Hæmatocele may be complicated by suppuration or by malignant degeneration of the testicle.

Suppuration may follow the use of the trocar, even though all ordinary antiseptic precautions have been taken, the conditions being extraordinarily favorable to germ-growth. At times it occurs without evident cause, though there is usually a history of preceding trauma. The hæmatocele and scrotum of the affected side become tender, painful, and swollen; the constitutional symptoms of suppuration develop; an area of softening appears; and a grumous, purulent discharge takes place, always through an insufficient opening when the process is left to the efforts of nature.

A few cases of malignant degeneration of hæmatocele have been recorded. Certainly in the great majority of such cases the hæmatocele is a complication of the cancer and secondary to it.

Diagnosis.—The complications of hæmatocele and its combination with tumors and diseased conditions of the testicle may make the diagnosis difficult or in some cases impossible. In traumatic hæmatocele the history of injury, followed by sudden opaque effusion into the vaginal tunic, associated with discoloration of the scrotum, establishes the diagnosis.

Irreducible omental hernia may strongly resemble a chronic hæmatocele. The latter begins in the scrotum, was never reducible, and its relation to the cord can be readily traced. There is absence of cough-impulse unless the hæmatocele extends well up into the inguinal canal.

Diagnosis from hydrocele is made by the absence of translucency; from old cases of hydrocele which may not be translucent by the absence of thrill and fluctuation; finally, by exploratory tapping or incision.

The diagnosis from chronic orchitis and malignant growths may be impossible unless testicular sensation can be elicited or a definite history obtained. In such case antiseptic incision, deepened cautiously, is the only method of safe and certain diagnosis.

Treatment.—Acute traumatic hydrocele is treated by rest in bed, with ice-bags to the elevated scrotum. Hot fomentations may be used in place of ice for asthenic patients or when the application of cold is painful. When the swelling begins to subside, strapping or the pressure of a well-fitted suspensory bandage is indicated.

When the effusion is very extensive, or when after two weeks there is no apparent absorption, tapping is indicated; and this procedure is still more urgently called for on the first development of inflammatory symptoms. When after tapping there is reaccumulation of blood, more radical treatment is called for.

The three methods of radical treatment applicable to chronic hæmatocele in its various stages of development are *incision and curetting*, *decortication*, and *castration*.

Incision and curetting is the simplest of these operations, and is generally successful when the thickening and degeneration of the hæmatocele walls are not too far advanced. The cavity of the cyst is freely opened by an incision, which is deepened most carefully when the position of the testis is not known. The contents are washed out, and the

whole interior of the sac scraped smooth by a curette. As much of the outer wall of the vaginal tunic as can be easily freed is cut away, and, the remaining cut border being sewn to the skin, the cavity is then lightly packed with iodoform gauze and allowed to heal by granulation.

When, from calcareous degeneration and great thickening of the walls, curetting will not make them sufficiently yielding to collapse and obliterate the cavity left by evacuation of the blood, *decortication* is indicated. This is practised by opening freely into the tunica vaginalis and dissecting back from the vaginal tunic the thick layers of false membrane. This sometimes may be done by the finger; more often it requires the use of the scissors or knife. When the false membrane is reflected close to the testis and cord it is cut away, the remaining edges of the vaginal tunic are sutured to the skin, and the wound is lightly packed.

Castration is indicated in the very old hæmatoceles of feeble subjects when there is strong reason to believe that the testis is already atrophied and useless. It may also be required when resort to other methods has proven futile.

Hæmatocele of the cord may be diffuse; the more common variety is encysted. Diffuse hæmatocele of the cord is due to rupture of one of the veins, either from increased pressure incident to muscular strain or from direct traumatism. A soft, semi-fluctuating, sausage-shaped tumor occupying the position of the cord and entirely obscuring it is quickly formed.

The immediate **treatment** has for its object the limitation of effusion and the prevention of inflammatory reaction: this is the same as that already described when treating of acute hæmatocele of the vaginal tunic. When the tumor steadily increases in size in spite of appropriate treatment, incision and drainage should be practised.

The chronic form of diffuse hæmatocele of the cord may reach enormous dimensions, and is characterized by great thickening of the limiting walls.

Encysted hæmatocele of the cord is due to bleeding into an encysted hydrocele or to encysting of a hemorrhage in the substance of the cord. It begins in the lower part of the cord, forming a pyriform tumor which ultimately may become merged with the epididymis and testis.

The **diagnosis** is much helped by the history of the tumor, especially its point of origin, and by the absence of translucence.

This tumor is treated by incision, turning out of clots, and decortication or complete removal.

Encysted hæmatocele of the testis is caused by blood-extravasation into an encysted hydrocele.

The **symptoms** are those of hydrocele, excepting the fact that there is no translucence, and the walls of the cyst undergo the characteristic changes already described.

Intratesticular hæmatocele is due to traumatism. Persistent pain and swelling after injury might suggest a parenchymatous effusion of blood. If the diagnosis can be fairly established, for instance, by detection of a softened or fluctuating area, puncture and drainage are indicated. Jacobson reports one case of parenchymatous hæmatocele of the epididymis.

Hydrocele.

Hydrocele is a condition in which there is an abnormal quantity of fluid around the testicle or cord in the canal of Nuck. It is usually unilateral. Prolongations of peritoneum, called the vaginal processes, precede the testicles in their descent into the scrotum, thereby forming a double serous covering on their anterior and lateral surfaces. This funicular pouch usually becomes obliterated from the internal abdominal ring to a point just above the testis, leaving a serous sac enveloping this organ in which sac is found a small amount of fluid: an excessive amount of fluid in this tunica vaginalis testis constitutes the common variety of hydrocele.

When the funicular pouch remains patulous from the abdominal cavity to the testis, a congenital sac is formed which when filled with fluid constitutes a congenital hydrocele; a collection of fluid within the funicular pouch, previously obliterated by adhesions at the abdominal opening and again at the upper level of the testicle, is called an encysted hydrocele of the cord.

The presence of fluid within the tunica vaginalis is due to either excessive secretion, passive exudation, or to defective absorption; depending upon its inflammatory or non-inflammatory origin, it will vary in its chemical composition.

The fluid of an acute hydrocele contains more fibrin and is of a higher specific gravity than the fluid found in a chronic hydrocele; the latter resembles ordinary ascitic fluid, and may contain cholesterin crystals and fat. In general terms it may be described as a serum-like fluid, varying in color from lemon-yellow to brown; containing salts, blood-corpuscles, cholesterin crystals, fat-globules, and water, with a specific gravity of about 1024, and upon boiling or the application of acid showing the presence of albumin in large quantities. An admixture of blood is especially common after the operation of tapping, and renders the sac less translucent. The quantity varies from a few drachms to several quarts, the average amount being perhaps about ten ounces. This fluid may be either serous, plastic, or purulent: the latter variety is rarely met with, though it may follow trauma, extension from contiguous structures, or the use of septic instruments for the radical cure.

The **pathological changes** met with in the tunica vaginalis are essentially the same as those occurring in serous membranes in other parts of the body, and vary with the duration of the disease: at first there is not much alteration, the sac remaining transparent and smooth; later a superficial exudate develops, which becomes organized into layers or bands of connective tissue. These layers may be placed one upon the other, or may stretch across from one side to the other as septa, causing in some cases bilocular or even multilocular sacs. They are also the source from which are derived the small cartilaginous bodies found in the sac of an old hydrocele, as in joints the seat of chronic inflammation.

In long-standing cases there may be calcareous deposit, rendering the sac of the hydrocele so stiff that it fails to collapse upon withdrawal of the fluid.

Repeated tappings produce a similar condition; only in this case the

thickening is fibrous and renders the operation difficult, the thickened tunic having sometimes almost the consistency of leather. From the increased weight and tension the scrotum becomes elongated and enlarged, the cord and cremaster muscle being similarly affected. The testicle, situated posteriorly and a little to the inner side, is usually unaltered by the presence of a hydrocele, but in long-standing cases, where the tunica becomes thickened or calcareous or where the amount of fluid is excessive, it may be flattened, atrophied, or folded upon itself; in rare cases occurring in double hydrocele the spermatic function is entirely absent.

Hydrocele may be either acute or chronic.

ACUTE HYDROCELE of the tunica vaginalis may be caused by traumatism, extension of the inflammatory process from neighboring structures, as orchitis or epididymitis, the prolonged employment of taxis for the reduction of a hernia, and the injection of irritating fluids for the cure of a chronic hydrocele.

The exudate is rich in fibrin, and is seen as flocculi or as a lace-like membrane spread over the surface; the fluid contains a large proportion of corpuscular elements.

The **prognosis** depends upon the cause; the inflammation, subsiding with the disappearance of the causative agent or the disease, may become chronic, the fluid changing in character with the subsidence of the acute symptoms until it approaches eventually the appearance of ascitic fluid.

Treatment is directed to the cause where that can be ascertained; with the disappearance of the orchitis or epididymitis the hydrocele usually subsides. In cases caused by trauma, elevation and the application of evaporant lotions, together with rest in bed, will usually be sufficient.

CHRONIC HYDROCELE is a painless, slow-forming enlargement of the scrotum, caused by a collection of fluid between the layers of the tunica vaginalis in excess of the amount usually found in this situation. It may be *inflammatory* in its origin, and some authors claim that there is a low grade of inflammation following prolonged exercise or strain, which may be accompanied by the production of serum within the testicular pouch; further, the loose cartilaginous bodies sometimes, but rarely, found within the sac may by their continued irritation cause an abnormal secretion of fluid.

More often, however, it is due to *passive exudation* caused by an obstruction to the return circulation. In this category are to be mentioned hernia, an ill-fitting truss, and the presence of filaria, but probably most important of all are hepatic and renal diseases. The frequent occurrence of hydrocele in warm climates and in persons suffering from malaria is explained by the associated hepatic enlargements met with under these conditions. Hydrocele often accompanies syphilis, tuberculosis, and malignant disease of the testis or epididymis. It is most often met with in middle life, when the causes enumerated are more likely to be active, especially the alterations in the circulation.

In general dropsy, on the other hand, though the scrotal tissues may be œdematous, fluid in the tunica vaginalis is seldom or never found.

Symptoms.—The swelling of a hydrocele commences at the base of the scrotum, gradually extending upward to the abdominal ring. It is

pyriform in shape, with its base downward and with its long axis almost vertical. There may, however, be an ovoid tumor with its long axis antero-posterior, though this latter condition is rare: a peculiarity of the tumor of a hydrocele is the position which it assumes in relation to the body. Hernias and solid tumors of the testicle hang pendent, while a hydrocele comes forward from the vertical line, and when pressed backward will spring again into its former position.

The cord can usually be felt at the apex of the tumor, and the testicular pain when elicited not only gives information as to the condition of this organ, but also as to its position—a fact of importance when it is necessary to insert a trocar.

The skin is smooth, white, and apparently normal. The enlarged veins show through the overlying integument. There is usually a complete absence of all inflammatory symptoms; pain, when present, is due to the weight of the tumor dragging down upon the cord and testicular nerves, and disappears when the tumor is supported.

If the tumor is held in one hand and lightly percussed with a finger of the other, a vibrating thrill is transmitted which is characteristic of fluctuation. There is no impulse upon coughing, and the swelling is dull on percussion, but is not so heavy as a solid tumor of the same size. The growth is usually very slow, insidious, and painless, and continues indefinitely, often reaching enormous dimensions, though usually relieved by the surgeon before it becomes very uncomfortable. The penis becomes partly or completely buried by the skin being drawn forward with the scrotum.

The most important symptom of hydrocele for diagnostic purposes is its translucency; this is not invariably present, but when it is it is conclusive; it also assists in locating the testicle. It is absent under many conditions, as when blood, cholesterin, or fat is present in the fluid of a hydrocele, when the tunic has become thickened or calcareous, and when there is an inverted testicle.

To elicit this symptom the patient is examined in a darkened room. The tumor is grasped near its apex with the left hand, and, the skin being made tense, the right hand is placed upon the tumor to cut off the rays of light from a candle or match held on the opposite side close to the scrotum; a pinkish glow will show over the entire swelling except where the testicle throws a shadow.

The use of a stethoscope affords an easy application of the same plan, the pencil of light passing through the tube of the stethoscope serving to illuminate the scrotum thoroughly. The small electric lights are especially useful for this purpose, and the electric lamp, when placed at the end of a short cylinder so arranged that the light is only seen through the end, gives a powerful localized light which, when the cylinder is pressed against the tumor, surpasses all other methods for ascertaining the transparency of a hydrocele. In cases where fluctuation, transparency, and testicular sensation cannot be elicited the aspirating needle will be found necessary to confirm the diagnosis.

The **differential diagnosis** is to be made from hernias, neoplasms, other varieties of hydrocele, and hæmatocele. The diagnosis from hernia, unless there exists a strangulated hernia with excessive exudation and without the general symptoms of strangulation, is usually not very difficult.

The impulse upon coughing, the percussion resonance, and (when reducible) the disappearing "flop" usually suffice, but in old cases of epiplocele and in enterocele in children it is sometimes the reverse. The shape and position of the swelling, its sudden ending external to the abdominal ring, the presence of the testicular sensation, fluctuation, and transmitted light, when obtainable, are symptoms of sufficient importance to establish the diagnosis in most cases.

When, however, a hydrocele becomes acutely inflamed from an injury or other cause, with pain and redness, and the history as to its formation is uncertain, the diagnosis becomes very difficult; the continued absence of abdominal symptoms will usually clear up the diagnosis.

In hydrocele in other situations the use of the light transmitted through an opaque cylinder offers the best means of diagnosis. Here, again, the position of the testicle in relation to the tumor is of significance, and finally the insertion of the exploratory needle or trocar will be conclusive.

From hæmatocele the more rapid growth of the swelling, the history of an injury or recent tapping, the absence of fluctuation and transparency will sometimes aid in the diagnosis; but in cases where the tunic is thickened or where the fluid contains blood, fat, or cholesterin crystals a diagnosis becomes very difficult if not impossible.

The same conditions often render the diagnosis from tumors difficult: when there is associated hydrocele the tumor may be overlooked until the fluid is removed.

The most common and most important complication of hydrocele is a coexistent hernia, the fluid being contained in a hernial sac, or the dragging of the hydrocele upon the peritoneum inducing a hernia which rests upon the upper end of the hydrocele. When the hernia continues to advance, it assumes a position behind the hydrocele in most cases.

The outlook for spontaneous cure is unfavorable in adults, though this is common in children. The tendency is to gradually and slowly increase in size and weight until the pain, inconvenience on account of its size, loss of the function of the penis, with the excoriation and irritation from the urine, cause the patient to seek surgical interference.

The less common dangers are loss of the spermatic function, hæmatocele from injury, and the production of a hernia; in case of operative interference with careless antisepsis suppuration and sloughing may ensue.

As regards the shape assumed by the varieties of hydrocele Griffiths concludes:[1] "1. That in the adult the distended tunica vaginalis usually assumes either a spherical or an ovoidal shape. 2. That in the child the sac of the tunica vaginalis is almost always of a pyriform shape, with a slight constriction near the upper level of the testis. 3. That this pyriform shape when met in the adult is due either to the persistence of the condition found in the child or to the incomplete obliteration of the lower end of the processus vaginalis, and the occurrence of a free communication between its cavity and that of the tunica vaginalis. 4. That the bilocular form of hydrocele occurs when the processus vaginalis remains unobliterated, being, however, shut off from the peritoneal cavity above, but communicating with the tunica vaginalis by

[1] *Loc. cit.*

an opening of variable size, depending upon the degree of constriction, at the line of junction of the processus and the tunica vaginalis. 5. That there is occasionally met with a multiloculated variety of simple hydrocele of the tunica vaginalis, in which the locules arise either from bulgings of the serous membrane or from the formation of incomplete septa between opposed parts of the parietal and the visceral layers."

Treatment.—Although hydrocele is one of the minor affections of the testicle, the number of operations that have been devised for its treatment, and the inability of all of them to cure the disease with certainty in every case, show the difficulty attending its treatment. The treatment of hydrocele is either palliative or radical—*i. e.* tapping when the tunica vaginalis becomes distended, or an operation having for its purpose the obliteration of the sac formed by the tunica vaginalis.

Palliative treatment, or simple tapping, consists in the puncture of the sac with a trocar and cannula and the drawing off of the fluid contained. Although this operation is a simple one, it should be done with the greatest precautions, both for the comfort of the patient and to avoid the accidents which sometimes follow it. The trocar to be used should be sharp, with a well-fitting cannula, and should be made aseptic by boiling or by any other of the usual methods. The scrotum should be washed with soap and water and an antiseptic solution. The position of the testicle having been determined by transmitted light, the sensations of the patient, and following down the spermatic cord, the scrotum is grasped above by the left hand and made tense, the patient standing against the wall to prevent flinching, or, better, lying down. A point is now selected at the junction of the middle and lower thirds of the scrotum, care being taken to avoid any large veins. The trocar is taken in the right hand, the thumb or index finger marking on the cannula a point one to one and a half inches from the point and preventing too deep a plunge. With a rapid, sharp stabbing movement the trocar is plunged vertically into the scrotum at the point selected, the trocar removed, the cannula pushed a little farther in, and the fluid drawn off by gently compressing the sac. The direction of the perforation should be directly backward, but as soon as the trocar has entered the sac the point should be directed upward to avoid the testicle.

After all the fluid has been removed the point of the puncture should be covered by a little pledget of cotton or antiseptic gauze and iodoform collodion. The patient should be advised to remain quiet, resting in bed, if possible, for the remainder of the day.

Accidents attendant upon Tapping.—If the above precautions are taken, no accident should happen. Puncture of the testis may occur if its position has not been established or if the trocar is plunged in recklessly. The sequelæ are sickening pain from the injury, hæmatocele, and orchitis: the latter is not serious if the instrument was aseptic. Cellulitis and sloughing of the tunics of the scrotum, the formation of abscess, and other accidents due to septic infection may follow the use of unclean instruments.

Radical cure, or operations performed with the purpose of obliterating the sac within the tunica vaginalis, are (*a*) those by the injection of irritating fluids with the purpose of producing adhesive inflammation between the layers of the tunica vaginalis; and (*b*) antiseptic incision

with or without removal of the parietal layer of the tunica vaginalis.

Treatment by Injection.—Among the various substances which have been employed, iodine is perhaps the most successful; pure carbolic acid has been used, and also has its warm advocates.

The injection of iodine should follow after all the fluid has been removed from the sac in the manner just described. When the surgeon is certain that all the fluid has been evacuated, he should inject a quantity of undiluted officinal tincture of iodine through the cannula. This should be proportional to the amount of fluid contained in the sac. The amount of tincture of iodine injected should be from one-eighth to one-fourth of the amount of fluid drawn from the sac. Care should be taken to remove the cannula and syringe together, so that all the iodine will enter the sac. To diffuse this completely over the tunica vaginalis the scrotum should be gently manipulated. The puncture should be closed by antiseptic cotton and collodion and the scrotum raised. The pain caused by the injection varies in intensity from a feeling of heat to severe nauseating pain that may extend to the groin, the perineum, and the neck of the bladder, and cause fainting.

The amount of swelling that follows is in accordance with the amount of inflammation produced. The patient should be warned that within the next twelve or twenty-four hours the scrotum will be swollen to its former size and possibly beyond it. The parts become red and tender, and there may be an accompanying fever. The patient should be confined to bed with the scrotum well supported, where he should remain for four or five days. After the swelling has attained its largest proportions it will gradually subside. The patient can usually leave his bed after the fourth day, but should wear a suspensory bandage until the swelling has entirely disappeared. The cause of failure in the use of this method is that a sufficient amount of irritation and inflammation has not been produced, either from too little iodine having been used or from some of the fluid having remained in the sac, and the iodine thus becoming diluted. On the other hand, so much inflammation may be produced in rare cases that treatment with ice and opium may be necessary.

The great majority of cases are cured by the method above described if the conditions are carefully fulfilled. The sac within the tunica vaginalis must be collapsed, so that the parietal and visceral walls come in contact, or adhesion cannot take place or the cure be effected. If the tunica vaginalis is much thickened or its walls stiffened by deposits of lymph, this condition cannot be fulfilled, and other methods are therefore more suited to these cases.

In congenital hydrocele or hydrocele of a partially closed hernial sac this operation would endanger the peritoneum; other operations, combined with the radical operation for hernia, must therefore be selected in such cases.

The injection of carbolic acid has been claimed by some authors to be as useful as the injection of iodine, and to do away, through the local anæsthetic action of the acid, with a large amount of pain. The amount used is either five to ten drops of pure carbolic acid liquefied in as little water as possible; or a drachm of 5 per cent. solution of carbolic

acid in glycerin. The method of procedure is similar to that described for iodine injection. When the cannula is to be withdrawn, an antiseptic ointment should be rubbed over the scrotum about it to prevent excoriation. Jacobson points out that this can be accomplished without the use of a special syringe. A large-sized 60-minim exploring hypodermic syringe may be thrust into the sac before the fluid is drawn off, the syringe containing the carbolic acid that is intended for use. The fluid is then drawn off by the usual method, the wound closed, and then the carbolic acid injected. The partisans of this method claim for it painlessness, greater certainty, shorter duration of treatment, and less risk of sloughing.

Its dangers are too great reaction, followed by cellulitis and sloughing, and the possibility of carbolic-acid poisoning, of which there are cases reported on very good authority.[1] Many cases of relapse have also been reported.

Treatment by Incision.—This method, though one of ancient practice, fell into disrepute through the resulting septic infection, cellulitis, and suppuration that followed it. After the introduction of antiseptic methods in surgery it was again brought forward by Volkmann, and has been used largely since that time.

The hair having been shaved from the scrotum and the field of operation well washed and made aseptic, the sac is made tense from above by an assistant, and an incision one and a half to two inches long is made vertically in the anterior lower third of the swelling. The layers are cut one by one, and the arteries are picked up with hæmostats until the tunica vaginalis is reached; before this is opened all bleeding must be permanently stopped. The sac is then opened, and when the fluid has escaped the cut margins of the tunica vaginalis are stitched to the skin with a few catgut stitches on either side. These serve to stop any bleeding that has not already been controlled by the hæmostatic forceps, which have been allowed to remain on until then. A drainage-tube is introduced into the cavity and the operation is complete.

The after-treatment consists in keeping the patient in bed with the scrotum raised and washing out the wound daily with an antiseptic solution. The drain is shortened every day, and care taken that bagging does not occur. The catgut sutures are to be removed on the fourth day.

The antiseptic dressings applied are various: an antiseptic sponge, hollowed out to receive the end of the drainage-tube, and a T-bandage are all that are needed. The cavity may be packed with iodoform gauze, and a large aseptic dressing applied over this, or the whole cavity within the tunica vaginalis may be swabbed out with cotton dipped in pure carbolic acid. The resulting suppuration is treated by drainage and irrigation, the wound granulating and closing from the bottom. The patient will probably recover sufficiently to return to his ordinary occupation at the end of three weeks, but will need to wear a suspensory bandage for some time longer. The resulting inflammation following this operation is seldom very severe.

Treatment by Partial Excision of the Tunica Vaginalis.—With the purpose of removing as great a portion of the pathologically secreting

[1] Murphy: *N. Y. Med. Rec.*, June 20, 1891.

surface as possible, Von Bergmann advocated, in addition to incision as performed by Volkmann, excision of the parietal portion of the tunica vaginalis.

The field of operation is prepared in the way already described. The sac is made tense by an assistant, and all layers divided by a vertical incision from top to bottom of the tumor down to the tunica vaginalis; all bleeding points are caught with hæmostatic forceps, and after complete hæmostasis the tunica vaginalis is incised sufficiently to admit a finger, and the condition and the position of the testicle clearly defined. The remainder of the sac is then split up with a blunt pair of scissors. The tunica vaginalis is then carefully dissected up from the scrotum; the free incision will make this easy, and renders possible a thorough examination of all the parts. The dissection should be made either with the scissors, or, as is generally possible and easier, the serous membrane may be peeled away by the use of dry aseptic or antiseptic gauze. Any bleeding points should be picked up with hæmostatic forceps, which should be left on until the operation is completed, as they act as retractors, and many points will be included in the sutures. When the parietal layer has been dissected free, it should be cut away as close to the testicle and epididymis as possible.

Any cysts or fibrous bodies found attached to the visceral portion of the sac should be ligated and cut away, as they tend to produce a return of the hydrocele by their irritation. The details as to closure of the wound vary. Von Bergmann inserts a drainage-tube after absolute hæmostasis and sutures the skin-edges together, placing over all an aseptic dressing with compression. M. Julliard leaves the parietal portion of the sac so long that it can be closely united over the testicle, leaving no intervening space; the drainage-tube is then inserted into the cellular-tissue space between this line of sutures and that uniting the skin-edges. Jacobson combines the method by incision and partial excision by removing a portion of the parietal layer of the tunica vaginalis down close to the testicle and epididymis, and then sutures the free edge of this parietal layer to the edge of the skin-wound with five catgut stitches, in some cases cauterizing the remaining portion of the parietal layer with silver nitrate, sometimes including the visceral layer. The external dressing should be antiseptic and compressing, the scrotum being raised up from the pubes, and great care taken to prevent infection by discharges from the rectum or by urine.

On the third or fourth day the sutures may be removed, and in case a drainage-tube is used it should be shortened gradually, as in the Volkmann operation. The patient is confined to bed by this operation for more than ten days, and may begin to get about between then and the eighteenth day.

The complications attendant upon this operation are those of any operation, and are due to negligence in the details of operating. They are hemorrhage, local sloughing, suppuration, erythema and cellulitis, and the persistence of a fistula.

Antiseptic Drainage.—The following method, suggested by Atherton,[1] may be tried with advantage in those cases which have not been cured by injection and in which the patient declines the cutting operation.

[1] *Lancet*, 1885, vol. ii. p. 1125.

The hydrocele is tapped in the ordinary way, but before the cannula is removed or the entire amount of liquid is drawn off a fine drainage-tube, antiseptically clean, is introduced through the cannula, and the remaining fluid passes through it, showing that it is within the tunica vaginalis. The cannula is removed and antiseptic compressive dressings are then applied, to be renewed every few days, the tube gradually shortened and finally removed. The author reports several successful cases.

The same principle in another form is advocated by Neumann.[1] The cannula, after the fluid is all withdrawn, is drawn out a little, and is allowed to remain *in situ* for two days under an antiseptic dressing; adhesions follow, and he claims a cure in from seven to nine days. In neither of these cases, however, have reports been made sufficiently late to judge from.

The Choice of Operations.—In the great majority of cases the favorable results that have followed the use of iodine injections, the freedom from the need of anæsthetics, and the dread of cutting operations, so common to the average patient, will make the method by injection of iodine the choice of the patient and of the operator. The indications for the use of antiseptic incision are—(*a*) in cases of previous failure with iodine; (*b*) where the sac is very large or has very thick walls; (*c*) where, on account of ill-health or premature old age, the rise of inflammation after iodine injection is especially to be dreaded; (*d*) in cases of congenital hydrocele, where a careful incision with antiseptic precautions will be safer than any other method if the pressure of a truss for the obliteration of the peritoneal communication cannot be persevered in; (*e*) where the surgeon is desirous of exploring the sac of the tunica vaginalis, as in cases where the enlargement of the testis is of a doubtful nature and coexists with a hydrocele, and does not yield to ordinary treatment; (*f*) where two hydroceles exist—*e. g.* vaginal and encysted hydrocele; (*g*) in some cases of hydrocele complicated with hernia—*e. g.* where the bowel is irreducible, and where, especially in unhealthy patients, there is a risk of the inflammation set up by the iodine extending to the peritoneal sac (Jacobson).

As my preference for the use of iodine may have led me to minimize the advantages of other procedures, I subjoin the conclusions arrived at by Morton[2] after a careful consideration of the subject: 1. Simple tapping, the injection of the tincture of iodine or carbolic acid, and aseptic incision (with or without excision of a portion of the sac) are alone employed to any extent in the modern radical treatment of hydrocele. 2. Although other injection materials—notably bichloride-of-mercury solution and iodoform—have been commended, yet clinical proofs of their efficiency are lacking. 3. Simple tapping, under full antisepsis, may be relied upon to relieve any hydrocele, and will cure a small percentage of cases. 4. The injection of moderate amounts of tincture of iodine (℥j to ℥iv) or carbolic acid (♏xx to ℥j) will cure about 85 per cent. of the simplest form of hydrocele. These two agents appear at present to stand almost upon an equality as regards percentage of cures and complications, but the acid has the advantages of not giving rise to pain or shock and of producing a much shorter period of disability; it appears also to be steadily gaining in popularity, and has cured many cases where the pre-

[1] *Fortschritte de Medicin*, Bd. xi. Heft 20. [2] *Philadelphia Polyclinic*, Sept., 1892.

vious use of iodine has failed. 5. Cocaine should not be employed to prevent the pain incident to injecting iodine, on account of its erratic and occasionally fatal constitutional effects. 6. The following conditions should prohibit any attempt at radical cure by irritant injections: (*a*) disease of the testicle or cord; (*b*) hydrocele complicated by hernia or the presence of a hernial sac, or where there is any doubt as to the relations of the hydrocele sac; (*c*) the presence of multiple cysts; (*d*) cloudiness of contained fluid; (*e*) thickening or tuberculosis of the cyst-walls; (*f*) presence of considerable pain; (*g*) presence of syphilis, tuberculosis, or any depraved physical condition: potassium iodide will cure most hydroceles of syphilitic origin; (*h*) where communication with the abdominal cavity cannot be excluded; (*i*) the failure of previous attempts to cure in this manner; (*j*) great size of cyst; (*k*) extreme old age or where the cyst is developed in childhood. 7. A considerable time should be allowed to pass after reaccumulation of fluid following injection before undertaking other treatment, as the effusion is apt to be inflammatory and to disappear in time. 8. While many complications, and even deaths resulting from attempted radical cure by the injection method, are on record, yet most of these can be traced to disregard of the above-mentioned contraindications, to the employment of too large a quantity of the irritant, to the neglect of antisepsis, and to injecting into cellular tissue. 9. The method of tapping and injection is the method *par excellence* for those not familiar with the technique of surgery. 10. Permanent cure may be anticipated with almost absolute certainty where the operation of incision and packing of the sac is performed. Failures under the Volkmann method can often be traced to—(*a*) overlooking small secondary cysts or cartilage-like bodies, or failure to recognize disease of the testicle or cord; (*b*) attempting to secure primary union; (*c*) too early removal of the drain-tube where that method of drainage has been made use of; (*d*) too small an incision. 11. The substitution of gauze packing for the drain-tube in Volkmann's operation will probably prevent most of the complications that have been reported, and secure, with proper attention to minute secondary cysts, a uniformly radical and safe cure. 12. The death-rate from simple incision and drainage is no greater than is that from injection of iodine. Sepsis and careless hæmostasis are responsible for almost all complications and reported fatalities. 13. Excision of a portion of the sac—Bergmann's operation—is probably unnecessary and unjustifiable, except where the tunic is exceedingly thickened or otherwise extensively diseased, as when containing calcareous patches or tubercular infiltration. 14. Incision of the sac may be performed under any of the conditions which contraindicate irritant injections, except extreme youth and certain constitutional conditions. 15. In double hydrocele both sacs should never be injected at the same time, but double incision may be done when the local and general conditions are favorable. 16. A radical cure can only be promised when incision is employed.

Congenital Hydrocele.—This form of hydrocele is often described as consisting of two varieties, the sac in one communicating with the peritoneal cavity, while in the other, more generally known as *infantile hydrocele*, that communication has been obliterated by adhesion of the wall of the funicular process at some point above the external ring.

Both forms are most common in infants, as they arise through the persistence of the same fœtal condition. It would seem more logical to call them both "congenital," reserving the term "infantile" for that variety of congenital hydrocele in which a partial occlusion of the funicular process has occurred.

Lovett[1] has carefully studied 30 cases of hydrocele in children occurring under his own observation, and has analyzed Wechselman's paper[2] based on 37 cases. Five of Lovett's cases were examples of encysted hydrocele of the cord. Of the remainder he says: "It has ordinarily been stated that the hydrocele of infants is easily reducible, the fluid running back into the abdominal cavity when the child is laid on his back and the scrotum manipulated. In these 25 cases of vaginal hydrocele the notes were defective in 3 cases, and of the remaining 22 cases, 19 were not reducible by any ordinary manipulation; that is to say, no connection with the abdominal cavity could be demonstrated. There may have been a valve-like opening which permitted the fluid to flow into the scrotum, and not out of it; or perhaps prolonged recumbency would have obliterated the hydrocele, but to the ordinary tests the fluid was not reducible in 19 out of 22 cases of infantile hydrocele.

Wechselman found in 37 hydroceles of new-born children only 14 which were reducible, while 23 did not communicate, so far as could be ascertained, with the abdomen. Bryant, in 124 cases of children and adolescents, found only 5 which communicated, while Melchior in 282 similar cases found only 21 which were reducible.

It is this class of cases of irreducible hydrocele which is of particular interest. When the funicular process of the peritoneum is open, it is easy to see the reason for the hydrocele. But when, to all intents and purposes, the funicular process is closed and the tunica vaginalis is a shut sac, it is more difficult to account for the presence of fluid in the scrotum.

It is evident that irreducible hydrocele may exist even in intra-uterine life, as is shown by cases of Schreiger, Tavignot, Von Ammon, and particularly Legendre, who found in a child which died almost immediately after birth a hydrocele the size of a hazelnut where the peritoneal process was completely obliterated.

Taking, then, the existence of irreducible hydrocele in intra-uterine life and in new-born children for an accepted fact, one is at a loss to account for it by the former theory that infantile hydrocele is due to a leaking of peritoneal fluid into the tunica vaginalis. It may be that the funicular process remains open unduly long and suddenly closes, leaving fluid in the tunica vaginalis. It may be that the accumulation of fluid results from traumatism at birth or afterward; or, finally, it may be due to an idiopathic, possibly an infectious, inflammation of the tunica vaginalis. It has been demonstrated that obstruction to the circulation in the cord does not cause hydrocele.

Symptoms.—The symptoms are those of hydrocele in general, but occurring in an infant they are more difficult to elicit. The swelling is distinctly pyriform, extending along the inguinal canal, and receives an impulse on coughing in addition; by steady pressure it decreases in size,

[1] *Boston Med. and Surg. Journ.*, Dec. 18, 1890.
[2] *Archiv f. klin. Chir.*, 1887, vol. xxxvi. p. 627.

the fluid returning into the peritoneum. This fluid recurs, and the swelling again presents itself even while the finger is placed over the external abdominal ring. These symptoms are more difficult to elicit the smaller the opening between the funicular pouch and the peritoneum. But in all cases there will be a history of the disappearance of the tumor during the night and its recurrence during the day. The impulse on coughing will be more distinct the fuller the communication is between the two serous pouches.

The infantile variety of congenital hydrocele is recognized by the same symptoms as ordinary hydrocele; it will, however, have the form of the funicular pouch, extending up into the inguinal canal or terminating just at or above the external abdominal ring. The permanency of its size and shape, its transparency, and the absence of gurgling on pressure distinguish it from the other variety and from hernia.

The **diagnosis** is to be made chiefly between congenital hydrocele and hernia. Both are noticed soon after birth in many cases, both extend up into the inguinal canal, and both receive an impulse on coughing. The distinguishing symptoms are the following: In congenital hydrocele the percussion-note is dull; the swelling is reduced gradually and without the characteristic slip and sudden jerk with gurgling that are present in hernia; the reaccumulation of fluid being slow, the tumor does not so suddenly regain its former proportions, and cannot be prevented from returning by pressure over the internal abdominal ring; the feel is that of a clear fluid in a sac; there are no less fluid portions and no gurgling showing the presence of gases; it is distinctly translucent. In congenital hernia, on the other hand, the percussion-note is resonant or semi-resonant; it requires slight taxis to reduce it, and slips back with the characteristic gurgling sound; it does not come down again if the finger is held over the internal abdominal ring; the consistency of the tumor may be either soft and even or irregular; it is usually opaque, but there may be a slight translucency from accompanying ascites.

The **complications** are hernia and suppuration: the former is rare, owing to the smallness of the communicating opening; the latter is a dangerous complication, since there is continuity of structure with the peritoneum. This complication is one of the impending dangers that accompany the persistence of this condition, and in advanced years may lead to fatal peritonitis from the extension of the inflammation from an orchitis.

Treatment.—The majority of cases are in young patients, and the treatment is therefore dependent upon the age. It may be either palliative or operative.

Palliative Treatment.—The continuous pressure of a well-fitting truss, aided, after a time, by acupuncture or tapping with a hypodermic needle, will generally suffice. If for any reason the truss cannot be worn or fails to produce healing, the use of iodine injections may be tried, provided a truss is worn for a few days beforehand and during the course of treatment. The fluid should be drawn off with a large hypodermic needle and about one-half to one drachm of the officinal tincture of iodine injected. This should be gently diffused throughout the sac, and then, for fear of too extensive inflammation, the excess should be withdrawn.

In these cases, however, the operative method of antiseptic incision, with the performance of a radical operation for the cure of any hernia that may be present, and the closure of the internal abdominal ring in any case, is much the best operation. The patient is prepared as for an operation for hernia: an incision similar to that for radical cure is made over the lower part of the inguinal canal. The funiculo-vaginal process is identified, carefully separated from the surrounding tissues and from the cord, divided a short distance above the testis, and converted into a tunica vaginalis. The remaining portion, separated from the surrounding structures, is treated as the sac of a hernia, and the radical cure performed by any of the well-known methods.

The INFANTILE VARIETY OF HYDROCELE is probably best treated by tapping with a hypodermic needle and the injection of iodine as described above.

FUNICULAR HYDROCELE, or ENCYSTED HYDROCELE OF THE CORD, consists of a collection of fluid within the unobliterated funicular pouch. It is limited above by the external abdominal ring and below by the testis. It may consist of one large sac, or there may be a series of small cysts along the course of the spermatic cord. It is frequent in children, though many cases are met with at an advanced age. The swelling is smooth, tense, and ovoid in form. If large, fluctuation may be detected, and by the use of a small electric lamp and stethoscope the transparency of the swelling may be ascertained. The testicle can usually be recognized below the tumor, and often a space separates the latter from the abdominal walls, though as the growth continues the separation will decrease and the sac may be continuously enlarged in an upward direction.

The **differential diagnosis** is to be made between encysted hydrocele of the cord and encysted hydrocele in other situations, as well as from hernia.

When situated low down upon the testicle, the question is hard to decide whether the fluid is in the funicular process or not; but by manipulation the testicle can usually be separated from the cyst; when the cyst is pushed upward toward the inguinal canal, the testicle does not follow so closely as it necessarily would in encysted hydrocele of the testis.

The chief diagnostic points by which it may be known from a hernia are the absence of the impulse upon coughing and inability to reduce it entirely within the abdominal wall, though small cysts near the external abdominal ring may be returned within the inguinal canal. There will also be absence of gurgling. The usual differences as to percussion and transparency exist, but are more difficult to elicit than in the vaginal variety.

Treatment.—Spontaneous recovery often occurs in children, and local counter-irritation may assist in removing the enlargement. Injection of iodine and the use of a seton may be employed, while incision under strict antiseptic precautions will perhaps be the safest method, as well as the most certain, of effecting a cure. The injection of iodine and the seton are open to the objection that diffuse inflammation so near the peritoneum may easily set up a general peritonitis. In elderly people, where radical measures are not desired either by the patient or by the surgeon, repeated tappings may be necessary to afford relief.

DIFFUSE HYDROCELE OF THE CORD is an infiltration of the connective tissues of the spermatic cord with serum. An œdematous condition of the tunica vaginalis communis occurs separately from general œdema of the penis and scrotum. The causation is obscure, but is probably due to passive exudation from pressure on the veins and lymphatics.

Symptoms.—The tumor is of moderate size, with a slight tendency to be pear-shaped, this pyramidal form increasing as the hydrocele enlarges. The enlargement is smooth and uniform, extending from the testis to or into the external abdominal opening, is painless, is doughy rather than fluctuating, and the testicle and epididymis are palpable below the hydrocele.

The **differential diagnosis** should be made from omental hernia, which will give a more distinct impulse upon coughing, is not so smooth, can be reduced completely, and will not return until the patient assumes the erect position; but in irreducible hernias in fat people the preoperative diagnosis may be impossible.

Encysted hydrocele of the cord may be mistaken in some instances, but attention to the symptoms enumerated in speaking of this affection will generally suffice to distinguish the one from the other.

Treatment.—Tapping and pressure should be resorted to primarily, followed by incision if these methods fail, but caution is necessary, for in both Scarpa's and Pott's cases death ensued from no other attributable cause than from great loss of fluid, the patient dying as from hemorrhage.

FATTY HYDROCELE has been variously described as chylous or milky hydrocele, and is the name given to a collection of fluid resembling milk or chyle in the tunica vaginalis testis. Fatty hydrocele may be produced in two ways: a lymphorrhagia may follow an actual rupture of the lymphatic channels or a leakage of lymph may occur through the walls of the vessels; this latter method is the more common, and is produced by obstruction to the return of the lymph either by an inflammatory process or the presence of a filaria.

Some authors maintain that the presence of fat is due to degenerative changes occurring within the sac of a simple hydrocele, the endothelial lining being the structure affected.

Whatever its causation may be, the density of the contained fluid renders the diagnosis more difficult than when the fluid permits the transmission of light. The other symptoms of hydrocele, however, are present, and the diagnosis can usually be made. If the hydrocele is double and the patient has inhabited a warm climate, a careful examination should be made to ascertain whether the filaria is present or not.

Treatment.—Incision under antiseptic precautions will be found the best method of treating this variety of hydrocele.

Injection of iodine may prove successful in some cases, but when the fluid is occasioned by a leaking lymphatic, it offers little hope of cure and is not without danger.

BILOCULAR HYDROCELE (first described by Lister)[1] may occur either from the persistence of the funicular pouch, with the formation of a

[1] *Edin. Med. Journ.*, 1856.

funicular hydrocele in communication with a hydrocele of the tunica vaginalis, or it may be formed by an infantile hydrocele communicating with a sac above it, situated above the internal abdominal ring in the abdominal wall. There are numerous opinions as to the position of the upper sac, but it is probable, as Tillman found in his case,[1] that the swelling develops between the peritoneum and the abdominal parietes.

Griffiths says:[2] "This form is characterized by being composed of two sacs, the one occupying the tunica vaginalis, and the other, which is often the larger, extending to a variable distance in the spermatic cord—it may be to the internal ring; and even beyond this point it may ascend in the abdominal wall between the fascia transversalis and the peritoneum. These two sacs communicate, as a rule, by a narrow opening at a point which corresponds to the natural line of constriction between the tunica and the processus vaginalis.

"The constriction which occurs at the internal abdominal ring in the process of shutting off the processus vaginalis from the peritoneal cavity is well recognized, but that which occurs below, immediately above the the level of the testicle, in order to shut off the cavity of the tunica from that of the processus vaginalis, has as yet scarcely received sufficient attention from anatomists and surgeons.

"The degree of constriction varies in different instances, and, accordingly, the aperture of communication between the upper and lower cavities. It seems therefore pretty clear that these cases of bilocular hydroceles, one locule of which extends up to the spermatic cord, are referable to incomplete obliteration of the processus vaginalis and failure of the natural constriction at its lower end to shut it off from the tunica vaginalis. This is the view adopted by Bazy, who based it upon the results of the examination of 68 examples of testicles removed at all ages up to thirteen years."

Symptoms.—In the lower sac the symptoms are the same as for hydrocele in general; further examination should be made to detect a communication between the upper and lower sacs. If one is found to increase in size as the other is pressed upon, and if by percussing the one a thrill is felt in the other, the communication can be considered probable, and can be confirmed by drawing off the fluid from the lower sac and evacuating the other also by this channel.

Treatment.—From its intimate relation with the general peritoneum it predisposes to dangerous complications in the event of inflammation occurring in the sac, and on this account, as well as the discomfort the pressure within the abdomen will cause, should be treated early.

Tapping may be resorted to as a palliative means and also as an aid to diagnosis. Injections would be dangerous for reasons given above, and the best method undoubtedly is by incision.

ENCYSTED HYDROCELE OF THE TESTIS.—There are usually described two varieties of this form of hydrocele—namely, encysted hydrocele of the epididymis, the fluid being encysted in tissues closely connected to the epididymis, which is the more common variety; and encysted hydrocele of the testis proper, the fluid being encysted between the tunica albuginea and the inner surface of the visceral tunica vaginalis. The former variety is supposed to arise from cysts formed (*a*)

[1] *Arch. für klin. Chir.*, Bd. xxvi. S. 1009. [2] *Journ. Anat. and Physiolog.*, vol. xxviii.

in subserous structures, but external to the epididymis and containing no spermatozoa; (*b*) in parenchymatous tissue, and usually containing spermatozoa.

Pathology.—Authorities differ in regard to the origin of these cysts, some holding that they are formed in the remnants of fœtal structures, others that they are involution-cysts originating in the tissue of the epididymis, but becoming subserous: the latter view is probably the one most compatible with the pathological facts as to diminished activity of the testicle, during which condition they are usually found.

Symptomatology.—The small cysts usually give rise to no clinical symptoms.

Large Cysts.—These cysts are parenchymatous, as they arise beneath the outer covering of the epididymis, usually close to its upper part or between it and the upper part of the testicle. They lie outside the visceral layer of the tunica vaginalis, raising that up as they become distended. They are in close contact with the seminal ducts lying within the parenchyma near the vasa efferentia. They are usually single, but may be multiple or multilocular. The fluid is usually milky from the contained spermatozoa, though it may be clear and limpid like ordinary hydrocele fluid.

Pathology.—The theories regarding the origin of these tumors are numerous, but the most reasonable are those that class them with retention-cysts, and those that attribute their development to fœtal remains. The evidence produced by authentic cases goes to show that these cysts may arise in either way, and that there is, in fact, more than one form of cyst that may be produced under these circumstances in the testicle. It is also perfectly certain that spermatozoa may find their entrance into these cysts by an aperture difficult to recognize at any time, and capable of closing long before the cyst is examined: on the other hand, however, other cysts of different origin may never have contained spermatozoa.

Encysted Hydrocele of the Testis Proper.—This is a form of hydrocele of rare occurrence: it is the development of a hydrocele between the tunica albuginea of the testis and the testicular portion of the visceral tunica vaginalis. They are usually found on the anterior surface of the testicle, and because of the density of their surroundings are small in size.

Symptomatology of Encysted Hydrocele of the Testis.—The symptoms are not very marked at first, and are slow in manifesting themselves, although they may increase rapidly from the rupture of a seminal vesicle into the sac following an injury. When small the hydrocele is difficult to make out clearly through the scrotum, but as it increases in size it stands out from the epididymis, and although, on account of the tension, fluctuation cannot be detected, translucency can be made out in many cases where it has reached a sufficient size. These hydroceles have sometimes been mistaken for supernumerary testicles. They seldom are found as large as a small hydrocele of the tunica vaginalis.

Diagnosis.—The translucency will distinguish the cyst from many other tumors, and it is the most characteristic symptom; in addition, the thrill and fluctuation upon careful examination, and finally the want of density and resistance, make a group of symptoms sufficiently clear to

establish the diagnosis when the shape and slow growth of the tumor are also taken into consideration. The small size and the length of the history of development should distinguish it readily from ordinary hydrocele. The shape is globular when small, but as the tumor may be multilocular the shape is varied. The testicle will be found, by transmitted light, usually lying below and anterior to the tumor, although it is sometimes to one or the other side, more frequently the inner. These symptoms are sufficient in ordinary cases, but sometimes exploratory puncture with an aseptic hypodermic needle will be necessary before the diagnosis can be established.

Treatment.—The slowness of the growth of these cysts makes palliative treatment of more avail than in other forms of hydrocele, and simple tapping is generally all that is required. If radical operation is attempted, though any of the methods given above may be used, the injection of iodine is the best. Care should be taken to inject it into the cavity of the cyst, and not into the tunica vaginalis.

HYDROCELE OF A HERNIAL SAC.—A non-obliterated hernial sac, into which the hernia can no longer descend, may become filled with a serous exudate, which is shut off from the general peritoneal cavity either by adhesions produced by the pressure of a truss or other irritations, or by the closure of the internal abdominal ring by omentum. The occurrence of these hydroceles is not common. They may exist in any hernial sac, but are most frequently met with after inguinal herniæ. The fluid is probably effused from the enlarged and distended veins of the thin hernial sac, which are compressed at its neck.

Symptoms and Diagnosis.—The ordinary symptoms of hydrocele are present in a tumor situated in a hernial region, with a history of a truss worn for a long time. The swelling fluctuates, is translucent, and possesses a distinct thrill on percussion. While there may be a slight impulse on coughing, it is not the expansile impulse of hernia, and the absence of all inflammation and tenderness, with the other characteristic symptoms, shows that it is not a strangulated hernia.

Treatment.—The best treatment for these cases is antiseptic incision, with removal of the sac and the strengthening of the closure at the hernial opening.

Beraud describes a variety of hydrocele which he called the "hydrocele diverticulaire," in which a pouch of large size was found in front of the tunica vaginalis, and this pouch communicated with the general cavity by means of a comparatively small opening. Being interested in the manner in which this diverticulum arose, he distended in many instances the tunica vaginalis with wax, and so obtained accurate impressions of the interior. These impressions showed that not unfrequently there existed small bulgings in the parietal layer of this serous membrane, and he thought that a further growth of one such bulging gave rise to the large diverticulum (Griffiths).[1]

VARICOCELE.

The term "varicocele," although it means literally any tumor formed of dilated veins, is applied to the dilatation of the veins of the pam-

[1] *Loc. cit.*

piniform plexus, and occasionally of all the veins of the spermatic cord. The spermatic veins commence in the testis and epididymis, pass out at their posterior border, and unite into larger vessels, which freely communicate with each other as they ascend along the cord and form the pampiniform plexus. Ultimately, two or three veins follow the course of the spermatic artery into the abdomen, where they unite into a single trunk, that of the right side opening into the vena cava, and that of the left into the left renal vein.[1]

The anatomical surroundings of these veins—particularly the fact that they are somewhat compressed above where they pass through the inguinal canal, and are very laxly supported below in the scrotum—render them extremely liable to over-distention; furthermore, as Jacobson points out, the small calibre and the great length of the vessels of the testicle produce a slowing in the stream of blood passing away from the gland, and thus "the slower the flow of the current and the more ill-supported are the veins in which the column of blood, but feebly supported *à tergo*, is moving, the more powerful is the influence which any added disturbance, no matter how trivial, if repeated or continuous, may bring about in parts like these." These are the natural predisposing causes of varicocele, and when we search beyond them we must do so almost purely by theory. The minute anatomical deviations in the course of the veins and the presence or absence of proper valves are of doubtful importance. The fact that the disease usually makes its appearance at or about puberty can be explained by the increased blood-supply to the parts at this period and the nervous excitation which produces irritation alternating with relaxation.

The disease, in a very mild form, is perhaps one of the commonest affections of the genital organs: it is estimated to be present in at least 10 per cent. of all adult males, but it is of pathological significance in a much smaller proportion of cases than this. It almost invariably occurs on the left side alone, but when this side is extensively affected the veins on the right side are likely also to be slightly affected. The preponderance of cases of left-sided varicocele is generally believed to be due to the fact that the left spermatic vein empties into the renal vein on that side at a right angle, whereas the right spermatic vein empties into the vena cava. Another explanation is, that the left spermatic vein, running behind the sigmoid flexure of the colon, is constantly subjected to pressure from accumulation of fæces in the bowel. The disease is most frequently found in young unmarried adults of weak constitution and nervous temperament; hereditary tendency to varicocele or to varicose conditions of the veins in other parts of the body may occasionally be elicited in the history of the case.

An acute onset of the disease is sometimes observed where the patient has been subjected to prolonged and violent muscular strain or has strained violently at defecation; otherwise, the disease is essentially chronic and insidious in its course and commencement. It seldom begins after middle age.

Symptoms.—Usually the first symptoms to which the patient's attention is called are the slight feeling of weight in the scrotum on the affected side and the presence of the elongated and tortuous veins, which

[1] Quain: *Anat.*

feel like a tangle of soft cords or a bundle of earth-worms, and which appear to envelop almost completely the whole testicle. As the dilatation of the veins increases, the left side of the scrotum becomes more and more relaxed and thinned, hanging lower than the other side; prolonged standing or walking, or sexual excitement, produces dull aching pains along the line of the cord, and possibly in the testicle itself or in the loins. In cases of long duration the scrotum becomes much elongated and the natural corrugations are smoothed out; it may become so thin and wasted that the convolutions of the veins are clearly visible through it and give the skin a bluish color. Occasionally the testicle on the affected side is slightly atrophied and somewhat softer than the opposite gland. The melancholy into which the patients fall who are afflicted with this disease is a marked symptom: they usually persist in believing that they are losing virility, in spite of assurances to the contrary. Occasionally, but rarely, genuine atrophy of the testicle does ensue from the interference with the circulation, but, as the opposite gland is usually normal, neither impotence nor sterility is threatened.

There is but small possibility that the disease will be mistaken for any other affection, unless it be an omental hernia: a decided differential characteristic between the two diseases is, that if the patient with varicocele lies down the scrotal tumor gradually disappears, and if then pressure is exerted over the internal ring sufficient to keep back a hernia, but not enough to stop the arterial blood-supply, and the patient then stands up, if the case is one of varicocele the dilated veins will again become apparent, gradually increasing from below upward, whereas a hernia would be retained in the abdomen as long as the pressure was maintained over the internal ring.

Treatment may be either palliative or radical. The palliative treatment consists of attempts to increase the tone of the walls of the veins and stimulate their contraction, at the same time giving them support. With these objects in view may be recommended—cold douches to the scrotum, regulation of the bowels, and the use of a firm, well-fitting suspensory bandage, or the use of a soft silver ring through which part of the scrotum is drawn, thus limiting the extent to which the testicle can descend. Besides these means the patient's mind should be set at rest, as much as possible, with the assurance that he is not becoming sterile, and everything should be done to divert his attention from his malady.

Radical treatment—that is, operative—is indicated when the patient suffers actual pain and disability, or when there is progressive atrophy of the testicle, or possibly when the mental depression of the patient seems to demand active measures for his relief. There are several methods of destroying the circulation in the veins and relieving the pressure. The following subcutaneous method of ligating the veins is known as Davat's operation: The scrotum and enlarged veins are taken between the thumb and fingers of the left hand, and by rolling the cord to and fro the vas deferens is separated and allowed to slip to the posterior part of the scrotum. A long hare-lip pin is then passed beneath the veins from one side of the scrotum to the other and about one inch below the ring. A second is passed half an inch or an inch farther down. A needle with an eye at the point and carrying a double ligature of fine aseptic silk is then inserted at the point of entrance of the

pin, and carried over the veins and between them and the skin, and made to emerge at the side of the pin at its point of exit. The loop is then secured and the needle withdrawn. The loop of the ligature is then slipped over the point of the pin, and the opposite ends are tied in a running knot beneath its head: when, now, the knot is drawn tight, it slips under the skin and compresses the veins between itself and the hare-lip pin. The same procedure is carried out with the lower pin. At the end of five or six days the pin is withdrawn, and the loop will come away with it.

Curling's modification of this method, in which originally only one pin was used, was the introduction of the second pin, and, after the veins had been ligated, the subcutaneous division, with a thin-bladed tenotome, of the portion included between the two ligatures.

The operation recommended by Gould consists of the division of the veins by means of a soft platinum wire heated to redness by a cautery battery. The skin is opened and the veins exposed through a small slit, and the wire is passed round the veins by means of an aneurysm needle.

Treves exposes the veins by an incision in the scrotum over the variocele and carefully dissects down to the enlarged veins; a carbolized catgut ligature is passed and tied tightly round the veins at the upper and lower angles of the wound, and the ends cut short. The mass of veins between the two ligatures is then excised, a small drainage-tube is placed in the wound, and the edges brought together. This is essentially the same as the operation known as Howse's.

Bennet's operation, up to the excision of the portion of the veins, is much the same, except that he does not actually denude the veins, but leaves a part of the enveloping fascia undisturbed; after the veins have been excised the two cut ends are brought together by tying the two ligatures; by this means the support of the testicle is strengthened and it is held up at a higher level in the scrotum.

Diseases of the Scrotum.

Description.—The skin of the scrotum is thinner, more elastic, and more distinctly pigmented than the surrounding skin, and is provided with sebaceous and sudoriferous glands and discrete hair-follicles. The raphe of the penis continues backward in the middle line of the scrotum to the anus. Under the influence of sexual excitement or the local application of cold the scrotum contracts, the skin being thrown into transverse folds; heat, fatigue, and debility produce relaxation, the folds disappearing and the skin appearing smooth and shining over the testicle. The left side of the scrotum is usually longer than the right.

Beneath the skin, and closely adherent to it, lies the dartos, a continuation of the superficial fascia of the surrounding parts. This fascia passes inward from the raphe to the under surface of the penis, forming a septum which divides the scrotum into two compartments. The dartos is made up of loose connective tissue and smooth muscular fibres, and is more abundantly supplied with blood-vessels, lymphatics, and nerves than any portion of the surrounding superficial fascia with which it is continuous. The attachment to the coverings of the testes and cord

is by areolar connective tissue, which allows considerable range of movement.

From these facts it follows: that the scrotum is extremely sensitive to irritants—applications of iodine, for instance, cause severe pain for many hours; that when wounded there is free bleeding, which, unless each wounded vessel is secured, continues and infiltrates the loose connective tissue; that the edges of wounds are likely to become inverted; that inflammatory swelling is rapid and extensive; and that septic processes spread rapidly.

Anomalies.—The scrotum may be cleft, as in hermaphroditism, or partially developed, as in monorchidism, or completely absent, as in anorchism.

CUTANEOUS AFFECTIONS.—The skin of the scrotum is subject to the general diseases which invade other parts of the cutaneous surface; there are, however, certain affections so commonly encountered in this region that they are worthy of note.

Intertrigo, or chafing between the opposed surfaces of the thighs and the scrotum, occurs chiefly in very stout adults or in infants; it usually yields rapidly to thorough cleansing and the application of astringent washes or dusting powders, and to separating the apposed skin surfaces, in the adult, by a suspensory bandage.

Eczema in this locality is a frequent accompaniment of diabetes or of the rheumatic or of the gouty diathesis, and often has a tendency to be exceedingly persistent, perhaps more so than in any other portion of the body. It is usually the erythematous variety which attacks this part, but in long-standing or frequently-recurring cases the skin becomes thickened and possibly fissured, and is the seat of intense itching. In addition to the usual remedies applied to eczema in general, Piffard[1] recommends scarifications and the production of free bleeding and exudation by means of a warm sitz-bath; the parts are then dried and sprayed with tincture of benzoin or some antiseptic solution, and the scrotum supported in a closely-fitting suspensory bandage. Another remedy which will often produce marked reduction of the induration is liquor potassæ; after its application a dressing of zinc ointment and a suspensory bandage should be applied.

Pruritis unassociated with appreciable lesion of the skin is another affection which is frequently associated with gout or rheumatism; in many cases, however, its etiology is obscure. The treatment must be mainly constitutional; local remedies usually prove of little avail.

Molluscum contagiosum occurs most frequently in children, and seems to have a special predilection for the scrotum. The lesions consist of small, waxy, almost spherical tumors or cysts situated in the superficial layers of the skin; they are seldom numerous, from three to ten being the usual number occurring at one time. They are usually sessile, but some few show a tendency to become pedunculated when they have persisted for a considerable time without softening; the development is always slow, and, though smooth and rounded at first, they become umbilicated, and in the centre of the depression a small black spot may be seen which indicates the opening into the follicle. The disease is

[1] *Morrow's System of Genito-urin. Dis.*, "Syph. and Dermat."

quite painless, unless, as rarely happens, inflammation is started in the neighborhood of the tumors. The lesions disappear spontaneously in the majority of cases, but, as the disease is undoubtedly contagious, it may be well to get rid of such points of infection by squeezing out the contents of the cyst and applying nitrate of silver or pure carbolic acid; pedunculated growths may be cut off with scissors and the base cauterized.

Steatomata, or *sebaceous cysts*, might readily be mistaken for molluscum contagiosum were it not for the fact that they rarely occur in children and have not the same waxy appearance. They may even become as large as hens' eggs; they are soft and doughy in consistence, usually single, although they may occur in groups, and when subjected to irritation they have a decided tendency to soften and suppurate. The skin covering the cyst becomes thin and tense as the tumor enlarges, and if there has been any inflammation, it may become adherent to the wall of the cyst. Incision and dissection of the entire sac is the only effectual method of cure.

ELEPHANTIASIS is an endemic disease of certain countries, but in the United States it is rare. Its exact etiology is obscure; in the countries where it is endemic it is generally supposed to be due to stoppage of lymph-channels by the ova of the filaria sanguinis hominis, but in this country and in England it has been observed in cases where the parasite was not present in the blood, but where the obstruction to the flow of lymph could be accounted for by the frequent attacks of erysipelas or by the cicatrices of syphilitic lesions or repeated attacks of dermatitis. Of the early stage of the disease when it attacks the scrotum very little is known; enlargement of the lymphatics of the groin has been observed in some cases; according to Prunner[1] the disease always begins, as far as can be ascertained, in the form of a hard kernel under the skin, usually at the bottom of the left side of the scrotum. "In proportion as this kernel spreads in all directions the skin over it becomes thickened and indurated, and appears furrowed, canaliculate, wrinkled, and glandular. At this period, also, the lower part of the abdomen becomes altered in form; it is elongated, while the lower extremities appear to be getting shorter—a result of the traction which the tumor exercises on the skin of the abdomen. . . . . In the same way the skin of the penis yields to the traction of the tumor and turns downward, beginning at the root. Hence this organ visibly diminishes in length, externally, till it is completely hidden in the tumor. Its cutaneous covering is connected merely to the glans, and forms a blind canal whose aperture is situated in front in the middle line of the tumor, and represents a kind of continuation of the outer extremity of the urethra. The skin of the penis, however, in consequence of the contact of the urine becomes converted into mucous membrane." These tumors may attain an enormous size, weighing even as much as two hundred pounds.[2] They are pyriform, and the skin in front and below becomes rough and somewhat excoriated from the irritation of the urine. It is not uncommonly associated with some degree of elephantiasis of the skin of the lower extremities, but the testicles and penis usually remain unaffected.

[1] Quoted by Kaposi: *Hebra on Diseases of the Skin*, New Syd. Soc., p. 153.
[2] Larrey: *Chir. milit.*, t. ii. p. 115, quoted by Jacobson, *Dis. of Male Org. of Gen.*

eatment.—In the early stage pressure by means of elastic bandages or a suspensory bandage which can be laced up on the tumor, electricity in the form of the constant current, the administration of the iodide of potassium, and electrolysis, may be serviceable. When a large tumor has formed, removal by cutting is the only method of cure, and in very many cases the results of the operation are extremely satisfactory. Since the testicles are not invaded and the function of the penis is affected only by the bulk of the growth, these organs should not be interfered with, but a cardinal rule of operation is to remove all infiltrated tissue. The hemorrhage from such a tumor is likely to be profuse; therefore all vessels should be caught as they are cut, or the bleeding may be prevented by the Esmarch tube or by acupressure-pins ied about the base of the growth; before these are applied a care- examination for hernia must be made. No general rule can be en for the planning of the incisions; they must be so made that all the growth can be removed, and, when possible, should be so designed that flaps of healthy skin can be transplanted for the partial or total covering of the sexual organs. Even though the testicles be left entirely bare after the removal of the infiltrated tissues, they will be covered in by granulation tissue.

PNEUMOCELE OR EMPHYSEMA.—Verneuil describes a benign subcutaneous or subserous pneumocele due to local puncture, as from a trocar, or wounds of air-passages or of the intestines, and a malignant bacterial pneumocele dependent on inflammation in the scrotum or near it.

The benign pneumocele recovers spontaneously, but recovery may be sometimes hastened by aspiration or puncture. The malignant pneumocele requires free incision, and flushing and drainage of the focus of infection. Indicating as they do a virulent infection, or at least its extremely rapid spread, pneumoceles are always serious.

ŒDEMA.—From its abundant vascular supply, its dependent position, its long tortuous veins, and its loose structure the scrotum is peculiarly subject to œdema, whereof the cause may be local or remote.

Local œdema may be dependent on mechanical obstruction or on inflammation.

Local obstructive œdema may be caused by the pressure of a truss, by lymphatic enlargements of the groin, in children by the presence of hydrocele, by blocking of efferent veins either through thrombus or tumor-pressure.

Inflammatory œdema may be due to extravasation of urine; to inflammation at or near the neck of the bladder, especially when the plexus of Santorini is involved; to infection of the scrotum or surrounding parts; to contusion, to eczema, to rhus-poisoning, or to any dermatitis.

Œdema traceable to a remote cause—*i. e.* general venous engorgement from imperfect heart-action—is noteworthy only from the fact that because of the structure of the scrotum such œdema may produce so much tension and swelling that the vitality of the parts is threatened, and this long before there is any marked infiltration elsewhere.

The treatment of obstructive œdema, whether it be general or local, should tend to the relief of the backward pressure; a tight-fitting suspensory bandage should be worn, and when the swelling is great the

patient should be put to bed, the scrotum elevated, and dilute lead-water applied. When the vitality of the parts is threatened, as shown by the formation of blebs and by a dark discoloration of the skin, tension should be relieved by multiple punctures made with a fine tenotome through the previously cleansed skin. After these punctures are made a warm wet antiseptic dressing is applied: these infiltrated tissues are peculiarly vulnerable to the pyogenic microbes.

Inflammatory œdema is best allayed by treating the cause of inflammation, which, if it be superficial as from the application of iodine, indicates cooling lotions, rest, and elevation of the parts. If the œdema is due to the formation of an abscess, the pus must be evacuated; if from urinary infiltration, free incision must be made and drainage provided for.

TRAUMA OF THE SCROTUM.—Contusions of the scrotum are characterized by rapid and extensive blood-extravasation, producing almost immediate discoloration, which may spread upward to the penis and the surface of the abdomen, and even to the inner surface of the thigh. The entire scrotum may turn a blue-black, and yet the vitality of the parts not be threatened. Exceptionally the blood becomes encysted, forming a hæmatoma; nearly always it widely infiltrates the loose subcutaneous cellular tissues. In any accident less severe than an extensive crush absence of the peculiar testicular pain shows that the testes have been spared. The immediate treatment consists in limiting extravasation of blood by elevation and the application of cold and pressure. Evaporating lotions, such as lead-water and laudanum, secure sufficient cold. Pressure is applied by means of the bandage termed the "crossed-of-the-perineum." This dressing, which offers practically the only means of applying continuous efficient pressure to the scrotum, testes, and perineum, is thus applied: A muslin bandage seven yards long and three inches wide is fixed around the pelvis by a circular body turn, placed beneath the iliac crests. It is then carried downward along the right groin, across the perineum, around the back of the left thigh at the position of the ilio-femoral fold, upward above the trochanter and below the crest of the ileum, completely around the body until it is just above the left trochanter, down along the left groin, across the perineum, around the back of the right thigh at the ilio-femoral fold, upward and forward just across the right trochanter, and is continued by repeating these turns till a firm dressing is formed.

After the subcutaneous bleeding has ceased and reactive swelling has subsided the pressure and support afforded by a properly-fitted suspensory bandage will hasten the complete absorption of the extravasation. When hæmatocele forms, and, after a reasonable time, shows no tendency to disappear, it should be incised, emptied, closed by suture, and the pressure-bandage applied.

Incised wounds of the scrotum bleed freely. Each bleeding vessel should be caught and crushed with forci-pressure forceps, twisted or tied. In applying sutures the tendency to inversion of the skin-edges incident to the close attachment of the dartos must be guarded against. Healing takes place rapidly under proper apposition.

Lacerated and contused wounds must be cleansed with more than ordinary care; infection once started in the loose cellular tissues is apt to spread rapidly unless the aseptic condition of the parts is absolutely

assured. It is well in such cases when suturing the wound to provide for free drainage, either by tubes or, better, by gauze packing.

When, as occasionally happens, the testicles are entirely exposed, they usually can be covered by suturing the integument; but, even when, from loss of substance, this is impossible, provided they were uninjured by the original trauma, they will suffer no serious injury; granulation tissue generally forms in sufficient abundance to cover them completely.

Punctured wounds are serious only because septic material may be carried beneath the surface and cause either deep abscess or a rapidly-spreading cellulitis. On the first symptom of deep inflammation such wounds should be freely opened to the bottom, cleansed, and drained.

Tumors of the Scrotum.—Of these, except sebaceous cysts, epithelioma is the most frequent. Hæmatoma, characterized by indurated walls and fluctuating, non-translucent contents; urinary cyst, lipoma, dermoid cyst, angioma, lipoma, often completely enveloping the testis and inseparable from this gland; fibroma, enchondroma, hard and soft carcinoma, and sarcoma,—have all been observed, but are extremely rare. It is sufficient to call attention to the possibility of their development.

Epithelioma (called also chimney-sweep's cancer) is, according to Butlin,[1] still very common in England, though the majority of surgeons hold that the disease is much less frequent than it was formerly. This form of epithelioma begins as a wart, sometimes as a hard nodule, which may remain perfectly benign for many years. The great majority of these warts never degenerate. In a certain proportion of cases the wart slowly extends and becomes ulcerated, at first superficially; a scab forms, which on being removed shows a surface of unhealthy irregular granulations. This ulceration becomes somewhat indurated, extends from the papillary layer to the deeper part of the true skin, and then rapidly spreads, involving a large surface of the scrotum and ulcerating into the skin and superficial fascia of the surrounding parts. Exceptionally the ulcer extends rapidly in depth, infiltrating the tunics of the testicle. The inguinal glands are early involved, and become hard, fixed, and painful; then soften, ulcerate, and become typical of malignant glandular degeneration. Unless the testicle or its coverings is involved, the lumbar glands are not infiltrated, at least not primarily.

The cause of epithelioma of the scrotum is connected with the irritation arising from the constant contact with the delicate scrotal skin of soot, or of certain vapors, such as that from paraffin.

The prognosis in untreated cases is absolutely bad.

That preventive treatment is successful is shown by the extreme rarity of the disease among those chimney-sweeps whose dress and habits tend to keep the parts clean.

There is but one curative treatment—early and complete excision. This should be practised in the pre-cancerous stage—*i. e.* on the first sign of irritation, discharge, or ulceration about a wart, and the cut should be carried wide of the growth. When the ulceration has become distinctly epitheliomatous in type the same treatment is indicated. Including the ulcerated area, at least one inch of the surrounding apparently healthy skin should be removed. If the vaginal tunic of the testicle is in the slightest degree involved, or is even adherent to the granulating

[1] *British Medical Journ.*, June 25, 1893.

mass, castration must be performed, and the entire inguinal chain of lymphatics of the affected side must always be dissected out, whether these glands are perceptibly enlarged or not. If so much skin must be removed that the testicles are left exposed, they may be covered by flaps from the surrounding parts, or, if this be impossible, they may be carried up beneath the abdominal integument. After operation and partial or complete closure of the wound the "crossed-of-the-perineum" will best hold the necessary dressing in position.

GANGRENE OF THE SCROTUM is a condition of more surgical importance and interest than most of the preceding diseases. It has been carefully studied by a number of surgeons, more recently by Allen,[1] who reports a case of doubtful origin with a history of suppurating inguinal bubo a short time previously, and with marked emphysema. Allen believes that the bubo may have been the starting-point of the disease, and refers to a number of clinical observations of scrotal gangrene in which lesions in the region of the groin were present. Devergie reports three cases: in the first there was an ulcer at the root of the penis; in the second, inguinal adenitis; in the third, a bubo; in all three there was erysipelas. Two died.

About 1885, Winslow, Jones, Tiffany, and Platt (quoted by Allen) in this country placed on record four cases in which gangrene of the scrotum supervened upon operation for removal of inguinal glands. In one patient erysipelas had plainly preceded the gangrene, and one case resulted fatally. In explanation of these cases Platt[2] attributes the gangrene to ilio-inguinal nerve-irritation reflected to the terminal filaments in the scrotal tissues. In support of this view he instances the reflex œdema which has been frequently observed clinically, as well as produced in the physiological laboratory, and the symmetrical gangrene of Raynaud's disease under the influence of the nervous system. Allen thinks that while it is true that the scrotum and groin are supplied from the same nerve-trunk, it is also true that the fascia of the groin is continuous around the base of the scrotum with the dartos and the lymphatics that terminate in the inguinal glands, and it is more rational to look for bacillary infection along the course of these favorably situated tissues than to invoke a reflex trophic disturbance in explanation. One of the most recent records of scrotal gangrene is that contributed by Bungner, in which, shortly after influenza, painful swellings appeared in the groins, and were followed within a few days by gangrene which denuded the testes; from a suppurating gland remaining in the groin cultures of the staphylococcus pyogenes aureus were obtained. Allen adds that the marked emphysema in his case suggests the presence of the bacillus aërogenes capsulatus, now so often discovered in cases of gaseous gangrene, or other gas-producing micro-organism, Koch's bacillus of malignant œdema, or, possibly, even the bacterium coli commune, which Chiari has just discovered in a septic emphysema following gangrene of the leg. From the clinical side alone, therefore, he thinks that suppurative lesions in the region of the inguinal glands favor the development of scrotal gangrene. "Among the causes of this distressing and and often dangerous condition, aside from urinary infiltration, erysipelas, thrombosis, embolism, and incidently influenza, which have been men-

[1] *Journ. of Cut. and Gen.-urin. Dis.*, Feb., 1894. [2] *Med. News*, Nov. 14, 1885.

tioned, we find reference to typhus, syphilis, gonorrhœa, diabetes, prostatic disease, pediculi pubis, ergotism, traumatism (faulty punctures and injections), and frost-bite."

When the sloughs have separated the remaining flaps of skin should be drawn together over the testicles as much as possible, and the parts sprayed with some antiseptic and stimulating lotion. Allen[1] emphasizes the fact that unless the testicles are involved in the process they should never be removed simply because they are exposed; they will eventually be covered in by granulation tissue even when only the merest shred of scrotal tissue remains.

Diseases and Injuries of the Penis.

HYPOSPADIAS AND EPISPADIAS.

Hypospadias is a congenital malformation in which there is complete absence of some portion of the floor of the urethra, through which the urine escapes instead of through the meatus; this deficiency of the lower wall may be situated either in the perineum, at the peno-scrotal junction, or at any point in the penile urethra anterior to it. The different varieties of hypospadias are named from the portion of the penis in which the abnormal opening occurs; thus when the deficiency is just below the glans the malformation is known as balanitic hypospadias; two or three inches back, it constitutes penile hypospadias; when the urethra terminates in the perineum and the scrotum is cleft, the condition is known as perineal or peno-scrotal hypospadias. When this latter variety is extreme, the scrotum is completely divided, and consists of two pouches into which the testicles may or may not have descended; the floor of the urethra is completely wanting in the perineum, and the opening may be readily mistaken for a vagina, of which the halves of the scrotum form the labia majora, giving rise to the erroneous diagnosis of hermaphroditism. In these cases the penis is decidedly atrophic and lies close within the fissure of the scrotum. When the opening is in the penile portion, the penis is always much curved and bound down to the scrotum, owing to the corresponding lack of development of the corpus spongiosum; the urethra in advance of the opening is always obliterated. In the balanitic form of hypospadias the opening is on the under surface of the glans, and the frænum may be completely absent; in place of the normal meatus there is usually a small depression or pouch which ends blindly; in extreme cases the glans seems to be divided into two distinct halves on the inferior surface. When the opening is rather far back, the patient is usually incapable of procreation, although he is not necessarily impotent unless the penis is very much curved. Glandular hypospadias is the most common form, and only in extreme cases is it of any pathological importance.

Treatment.—It cannot be said that the treatment of hypospadias ever completely meets all functional demands. To make a conduit for the urine is comparatively easy, although it is apt to be a tedious matter by reason of the liability of the sutures to give way. The operation which is generally the most successful is that adopted by Duplay, consisting of three stages, of which the first is the straightening of the

[1] *Op. cit.*

penis by transverse incisions in the ridge which binds the glans down to the abnormal opening. Between this first stage of the operation and the second, ample time, possibly three or four months if there be marked curving of the organ, should elapse, in order that the tissues shall have thoroughly recovered before the more extensive process of repair be undertaken.

The second stage of the operation consists of the restoration of the meatus and of the urethral canal up to the point of abnormal opening. This can never be completed at a single operation, but usually takes three or four, distributed over a period of six to eight months. At the first of these operations little more than the formation of a meatus can be accomplished: in order to reconstruct it the edges of the cleft in the glans are denuded or a slit is made in the bottom of the cleft, and the two edges united over a soft-rubber catheter, which is removed permanently only when the wound has healed firmly. The remaining portion of the canal up to within a short distance of the hypospadic opening is formed by making two parallel longitudinal incisions, about a quarter of an inch apart, extending from the base of the glans downward; the two external edges of the central strip thus formed are then dissected up slightly, and the lateral skin of the penis dissected up at the outer border of the two longitudinal incisions to such an extent that it can be stretched forward from the two sides and united in the median line over the groove now formed by the central strip. A soft-rubber catheter is then placed in the median groove, and over this the two lateral flaps are stretched, and, brought together, are held in place by a quilled suture of silver wire or silk, perforated shot or perforated leaden plates or tubes being used to fasten them. The canal thus formed will have a roof and sides lined with skin, and the floor will be a very narrow strip of granulations; and Duplay claims that no contraction of the canal results from the cicatrix thus formed.

The third stage consists of freshening the edges of the small abnormal opening which remains, and uniting them with the same kind of suture as used before, over the catheter.

Epispadias is the congenital absence of the roof of the urethra: it is a much rarer anomaly than hypospadias, and, owing to the fact that it is frequently associated with exstrophy of the bladder, it is a more troublesome and serious condition. It may be confined merely to the glans or it may involve the whole penile urethra, the abnormal opening being close to the symphysis. When it is associated with exstrophy of the bladder and congenital absence of the symphysis, there is no possibility of forming a serviceable urethra; when only the penile urethra is at fault, the same operation as for hypospadias may be performed, but the deformity of the penis is usually so great that it makes the operation almost useless. The rarity of balanitic epispadias is shown by the fact that, as far as can be ascertained, only three such cases have been reported.[1]

Inflammation of the Penis (*Penitis*).—Inflammation of the erectile tissues of the penis is usually caused either by the extension of a severe infectious urethritis, by a phagedenic chancre or chancroid, or by a contusion, all of which may give rise to septic thrombosis in the cavernous tissue.

[1] Tilden Brown: *Morrow's System of Gen.-urin. Dis.*

The **symptoms** are redness and œdematous swelling of the skin and constant, slightly painful erection of the penis. Fever and rigors soon develop, owing to the easy access which the septic material has to the general circulation, and there is always grave danger of the development of pyæmia unless treatment is at once begun.

Treatment.—Free incisions must be made in the skin of the penis to relieve the tension, and the penis be swathed in cooling antiseptic lotions; if any patches of induration or fluctuation or gangrene appear in the erectile tissue, they should be freely incised and curretted and the gangrenous tissue cut away. Jacobson[1] recommends a hot boracic-acid dressing, frequently renewed, with iodoform, and the sloughy parts are to be painted every six or eight hours with the strong tincture of iodine.

Chronic circumscribed induration of the corpora cavernosa is a condition of somewhat vague etiology. Finger states that it does not follow florid infectious urethritis, but develops in an insidious manner after such a process has run its course; while Jacobson expresses the belief that gout is probably much the most common cause.[2] Be this as it may, the condition consists of the formation of small circumscribed indurations—that is to say, from a quarter to half an inch in diameter—in the erectile tissue on the sides or dorsum of the corpora cavernosa. They may feel like cords or bands more or less completely encircling one corpus cavernosum, and at a right angle to the axis of the penis (Jacobson); or, as is more commonly observed, the induration is in the form of flat, firm, and resilient nodules, which, however, never extend through the whole thickness of the cavernous bodies. These indurated masses are not of themselves painful, but from their inelasticity they interfere materially with the expansion of the organ during erection. Two or more of these nodules may be present in one or both of the corpora cavernosa; they give the penis a curved and distorted appearance when it becomes erect.

The **prognosis** as to cure is unfavorable, but in gouty patients the likelihood is that these indurations will not increase, and unless they are unduly irritated they will not give rise to suppuration.

Treatment is unavailing: in those cases which appear to be due to a gouty diathesis anti-gout remedies may occasionally do good.

Gangrene of the penis in certain rare cases may occur in the course of infective fevers, such as typhus or virulent typhoid, but in the majority of instances it is the result of mechanical obstruction to the circulation either by morbid changes in the tissues, such as phagedena, or extravasation of urine with the consequent swelling and œdema of the part, or by the constriction caused by bands of string, metal, or similar substances which have been put upon the penis and left until they cannot be slipped off. An unreduced paraphimosis may also be mentioned as a cause of gangrene of the prepuce and glans.

Treatment.—When the process has become established free incisions should be made through the skin to relieve tension and allow for the escape of the pus or other products of inflammation, and the parts should then be covered with a dry dressing of iodoform or boracic-acid powder until a distinct line of demarkation forms. After this the separation of

[1] *Op. cit.*, p. 671. [2] *Op. cit.*, p. 678.

the sloughs should be hastened by the application of warm antiseptic fomentations, and the gangrenous patches curetted or cut away with scissors. Circumcision may be performed before the line of demarkation has formed in those cases where it is evident that only the prepuce is affected.

PHIMOSIS.

Phimosis is a condition where the prepuce is abnormally long and the aperture is so small that the glans cannot be protruded; the contraction may be such that the passage of urine is materially impeded. In infants there is also a considerable degree of adhesion between the mucous membrane of the prepuce and the glans penis. It occurs as a congenital malformation in the majority of cases, but it may result from cicatricial contraction or inflammatory swelling following an injury. The immediate and local symptoms are merely those of irritation of the glans and prepuce, induced by the accumulation of smegma and the retained salts of the urine, which may eventually form calcareous concretions and give rise to a serious degree of balano-posthitis or of balanitis. Where the preputial orifice is exceedingly contracted it gives rise to "ballooning" of the prepuce each time the patient urinates; this overstretching of the prepuce in turn gives rise to constant minute ruptures of the mucous membrane, which then either ulcerates or forms firm inflammatory adhesions to the glans, not like the delicate congenital epithelial adhesions, which are easily broken down. The condition is, however, of more than local importance: the constant irritation to which the genitals are subjected and the impediment to the flow of urine are apt to induce grave reflex nervous symptoms—chorea, epilepsy, paralysis; or symptoms of urinary obstruction—frequent micturition from vesical irritation, cystitis; hernia or *prolapsus ani* from the straining at urination; and finally pyelitis or hydronephrosis. If the condition remains unalleviated until late in life, it becomes one of the commonest causes of epithelioma.

Circumcision is clearly indicated when any of the conditions just mentioned are the results of phimosis. The operation is a simple one, and no child is too young to be subjected to it.

The two layers of the prepuce—viz. the skin and the mucous membrane—having been rendered as aseptic as possible in the usual manner, the prepuce is drawn forward so that it can be caught in front of the extremity of the glans by a pair of long-bladed catch-forceps, which are slanted somewhat in the direction of the dorsum of the glans parallel to the median line. The projecting portion of the prepuce is then cut away along the anterior edge of the forceps. Fenestrated forceps are often used, the incision being made through the fenestrum. On removal of the forceps it will be found that, while the skin retracts to the corona of the glans, the mucous membrane still covers it like a hood; this is divided by an incision in the median line up to the dorsum of the glans near the corona, and then should be trimmed off at a distance of an eighth to a sixteenth of an inch from the point of reflection and following the curve of the coronal edge. Whether the frænum should be divided or not depends upon the amount of hypertrophy present at that point. When this strip of mucous membrane is left too long, it brings

the skin forward with it when healing takes place, and from the cicatricial contraction at the line of incision phimosis recurs.

In infants the mucous membrane and skin need not be stitched together, but in adults or children, where erection of the penis is likely to cause a separation, several stitches will be necessary. The only hemorrhage of any moment occurs when the frenal artery is cut; this should be ligated with catgut. Usually all other hemorrhage ceases as soon as the stitches are taken, but if it persists, any bleeding vessel should be tied and not twisted. The line of incision is then dressed with some unirritating antiseptic dressing. Bransford Lewis has lately published[1] a method of performing this operation by passing the sutures before cutting off the prepuce. For its performance he has devised a tractor which consists of two narrow blades, one a little longer than the other, and both serrated on their outer surfaces; these blades can be separated by means of a screw. The object of this instrument is to draw forward the mucous membrane rather than the skin of the prepuce. Another instrument which is necessary for the operation is a narrow, slightly curved, fenestrated clamp. The operation is described as follows: The tractor, closed, is inserted with the long arm upward beneath the prepuce, and then the blades are distended sufficiently to engage the serrations firmly in the inner surface of the prepuce and pull upon the mucous layer especially; the clamp is then applied in front of the anterior extremity of the glans. Hemorrhage is guarded against by encircling the penis about its base with a rubber band. Beginning at the dorsal fold, a 10 per cent. cocaine solution is injected between the mucous and tegumentary layers; there is no danger of its general absorption, since the clamp and the rubber band are between it and the general circulation. The traction on the mucous membrane is now strongly increased, and six 10-inch catgut sutures are run through the four layers of the prepuce between the fenestrations of the clamp. The foreskin is then removed and the clamp opened; the sutures running between the two apposed layers of the prepuce are hooked up in the middle and divided, thus making two rows of sutures ready for tying; two additional sutures are then inserted on the dorsal and on the frænal portions. With the tying of the sutures the operation is completed. The dressing consists of a square of antiseptic gauze perforated for the meatus and held in place with a moistened crinoline bandage.

EPITHELIOMA OF THE PENIS.

The penis and prepuce are among the rarer localities for the development of epithelioma, whereof the frequency in this situation has been variously estimated to be from 1 to 2 per cent. of all cases of cancer. As may be noticed in other parts of the body, the epithelioma appears to start from some slight but persistent form of irritation; in the region in question this irritation is usually brought about either by a long and contracted prepuce, under which the smegma accumulates and even calculous masses may form, or by warts on the glans or in the coronary sulcus; occasionally the epitheliomatous growth starts in a neglected chancrous or chancroidal ulcer, or it may not begin until years after the chancre has healed, but has left an indurated cicatrix, which from irritation again breaks down and develops into the epitheliomatous ulceration.

[1] *Med. Fortnightly*, St. Louis, Jan. 15, 1895.

The disease usually does not occur until middle life, and when it has once begun the course is the same as that of cancer of the epitheliomatous variety in other parts of the body. Fayrer reports[1] a case of malignant disease of the scrotum and penis occurring in a youth of seventeen: the diseased parts were removed by an extensive operation involving the penis, scrotum, and testicles, and six months after there had been no recurrence of the disease and apparently no involvement of the lymphatic glands.

The disease first appears as either a papillomatous fungoid growth or as a flat ulcerated patch with slightly indurated base. Jacobson[2] clearly describes the subsequent progress of the ulceration as follows: "The ulcer becomes excavated to a varying depth at different parts of its surface; its base and its edges are extremely hard, owing to their consisting of growth infiltrating into the adjacent tissues. For the same reason the base is fixed. Its surface varies: at one part it is sloughy and perhaps grayish-yellow, at others granular and almost clean, or prominent with flabby, florid granulations prone to bleed and scab, and in their turn breaking down. Other parts of the surface of the ulcer may be nodular or warty. Whatever its appearance, the surface is prone to bleed; it is exquisitely tender, while from it exudes a thin and most disgusting fluid, apt to form scabs and crusts. The borders of the ulcer are raised and often everted; they may follow a smooth and uniform course, like a well-raised embankment, or be sinuous or zigzag. In other cases, instead of being smoothly rounded to one level, they are heaped up at places, or nodular or warty." As the disease advances the general condition of the patient declines—not, however, with the same rapidity as is usually observed in cases of malignant growth in other parts of the body; the inguinal glands are affected very early, but metastases to other organs are rare. Strange to say, the urethra often escapes destruction even in the midst of the ulceration.

Between chancre and epithelioma of the penis the differential diagnosis is often perplexing, but the following characteristics of the two lesions will usually serve to make the distinction: Chancre is rarely painful; it may occur at any period of life; its surface is generally smooth and the secretion slight; the lymphatic glands in the groin and also in certain distant parts of the body become affected in the course of a few days after its appearance. Epithelioma of the penis is invariably somewhat painful; it commonly does not occur before the fortieth year; its surface is irregular and more or less nodular; the secretion is rather profuse and very offensive; the glands do not usually become affected until some months after the appearance of the lesion, and the adenopathy is chiefly confined to the inguinal region.

Treatment.—When the disease is seen in its earliest stage and before the inguinal glands have become involved, its further progress may be checked by vigorous curetting and cauterization; when it is confined to the prepuce, circumcision at this early stage may prevent metastasis to the glands. But if, as is more commonly the case, it has already involved the glans, nothing short of amputation of the penis considerably beyond the area of infiltration is of any avail.

Amputation of the penis may be performed either by a circular incis-

[1] *Brit. Med. Journ.*, May 30, 1891. [2] *Dis. of Male Organs of Generation*, p. 710.

ion or by the formation of flaps. The flap amputation is performed as follows: Provision is first made against hemorrhage by encircling the base of the penis with an elastic bandage; traction is then made upon the prepuce and sheath of the penis; dorsal and lateral flaps, which include the tissues down to the tunica albuginea, are now made. The corpus spongiosum is then severed by inserting the knife between it and the corpora cavernosa, and cutting downward and forward. After dissecting out the urethra to the base of the flaps, the corpora cavernosa are divided and an ample-sized hole cut in the dorsal skin-flap, though which the urethra is made to pass. The ligature round the base of the penis is then relaxed and all bleeding points secured. When the flaps have been brought together with sutures the urethra is slit up laterally, and the two flaps thus formed are stitched to the edges of the hole in the dorsal flap. A retained catheter will be required for a few days, and the surrounding parts should be protected from the irritation of urine, which may leak out, by an antiseptic dressing, preferably of iodoform, which should be changed daily while the parts are being irrigated.

In the circular method, after making the skin-incision directly round the penis, the corpora cavernosa and the corpus spongiosum are divided, the latter being left slightly longer than the former, so that the urethra will be sufficiently long to be brought out and sutured to the margin of the skin-incision as in the flap operation.

Extirpation of the penis is sometimes required when the organ is affected as far back as the pubes. The operation is performed as follows (Treves): The patient is placed in the lithotomy position, and an elliptical incision is made around the base of the penis; the skin of the scrotum is incised along the whole length of the raphe. With the fingers and the handle of the scalpel the halves of the scrotum are then separated down to the corpus spongiosum. A full-sized silver catheter is then passed as far as the triangular ligament, and the knife is inserted between the corpora cavernosa and corpus spongiosum. The catheter having been withdrawn, the urethra is cut through at the back part of the bulb. The urethra is then detached back to the triangular ligament. The suspensory ligament is then divided and the penis separated from the soft parts down to the attachment of the crura; each crus is then separated from the pubic arch by means of a strong periosteal elevator. The edges of the incision in the scrotum are then brought together and the cut urethra stitched to the margins of the skin. The wound requires drainage with the tube so placed in the deep part of the wound that its ends can be brought out in front and behind; no catheter need be retained in the urethra. The operation is always protracted, owing to the close and firm attachment of the crura to the rami of the pubes, and during their detachment the hemorrhage is likely to be excessive. Four arteries—the two arteries of the corpora cavernosa and the two dorsal arteries—require tying.

Diseases and Injuries of the Male Urethra.

A very brief review of the anatomy and physiology of the male urethra is given here to emphasize the conditions which have a direct

bearing on the diagnosis and treatment of the diseases to which this portion of the genito-urinary system is liable.

The urethra is the common conduit for the outflow of the urine from the bladder and the semen from the seminal vesicles, and, although somewhat irregularly cylindrical when distended, a transverse section of it when it is empty and the walls collapsed would present the appearance of a slit rather than of a canal. Its average range of length is from $6\frac{1}{2}$ to $8\frac{1}{2}$ inches, but the length is somewhat increased when inflexible instruments are introduced, owing to the stretching of the parts, and may be found to vary from 8 to 9 inches. In its course from the bladder the urethra pierces the prostate gland from base to apex, both layers of the triangular ligament, and extends the entire length of the corpus spongiosum. The three divisions are therefore named respectively the prostatic, the membranous, and the spongy portions. The length of the prostatic portion is about $1\frac{1}{4}$ inches, the membranous portion about $\frac{3}{4}$ of an inch, and the spongy or penile portion about $6\frac{1}{2}$ inches.

The urethra at the meatus is at its narrowest: just within the meatus it widens, forming the so-called fossa navicularis. The entire spongy portion is somewhat smaller in circumference than the fossa navicularis, and is fairly uniform in size, but points of slight physiological contraction have been demonstrated. The canal again enlarges at the bulb, but becomes narrower at the membranous portion, and presents a spindle-shaped enlargement as it passes through the prostate, where it has the largest calibre and is the most dilatable. These variations in the calibre of the urethra have an important bearing on the treatment of certain affections.

The urethra may also be described as having a movable and a fixed portion, the movable portion being the anterior three-fourths of the spongy urethra, sometimes called the pendulous portion; the fixed portion, extending from about an inch and a half in front of the bulb to the bladder, includes the membranous and the prostatic portions, the membranous portion being the more fixed of the two. The fixed urethra curves upward and forward, the lowest portion being that in front of the anterior layer of the triangular ligament, in which position it is about 1 inch below the pubic symphysis. The curve of the fixed urethra has been found to be very constant, and corresponds to the arc of a circle $3\frac{1}{4}$ inches in diameter, the chord of the arc measuring $2\frac{3}{4}$ inches. In children and small spare adults the curve will be represented by the arc of a somewhat smaller circle, while in large and stout persons the curve will correspond to a rather larger circle.

In the pendent position of the penis the movable portion of the urethra forms a curve in the opposite direction, so that, viewed laterally, the whole canal forms a somewhat irregular S-shaped curve; when the penis is erect this second curve is obliterated.

Guyon[1] has given a description of the anatomy of the urethra viewed from a surgical standpoint which contains so many useful practical points that it seems worth while to add a portion of it to the above description. In doing so I avail myself of an excellent abstract by William Mastin,[2] of which I have previously made use.[3]

[1] *Leçons cliniques.* [2] *Annals of Surgery*, Aug., 1882. [3] *Morrow's System*, p. 275.

Guyon divides the urethra into six regions: 1. The navicular region, which corresponds to that part of the urethra surrounded by the glans penis and extending from the meatus externa to the corona glandis. 2. The penile region proper, reaching from the termination of the navicular region to the entrance of the urethra into the scrotum. 3. The scrotal region, including, of course, all that part of the urethra contained within the limits of the scrotum. 4. The perineo-bulbar region, which extends from the posterior limit of the scrotal sac to the passage of the urethra under the pubic arch. 5. The membranous region. 6. The prostatic region.

These regional divisions, he declares, are amply justified by clinical experience and certain distinguishing features.

In connection with the navicular portion is to be remembered the care to be exercised in the employment of fine instruments, presenting them to the inferior and not to the superior wall, as is the rule in the other regions, the arresting of extraneous bodies, and the frequency of cicatricial strictures. The penile is the portion which is the most movable, the most superficial, and the least fixed. In the scrotal portion, which is deeper and more fixed, stricture is comparatively rare; foreign bodies are seldom arrested; and when it becomes necessary to open it—for instance, during the swelling and thickening attending abscesses or urinary infiltration, when it is difficult to trace by the finger an instrument introduced into the canal—the median line is the most convenient guide. The perineo-bulbar portion is really fixed and deep; it is the seat of election for blennorrhagic contractions, and here, too, traumatic strictures from deep contusions and lacerations of the urethra are more frequently encountered.

Guyon directs attention to the fact that the inferior wall is extensible, soft, and depressible, and is subject to variations of both form and length; hence the important point to be borne in mind by the surgeon is, that in catheterism he should either follow exactly in the curve of the superior wall or modify the direction of the urethra; and to determine the adaptability of the canal to instruments anatomy must be depended upon to indicate to us the normal direction of the urethra and the limit of modification which it will bear without sustaining a lesion; and here it is to be especially remembered that the first part of the urethral curve—that extending from the suspensory ligament to the entrance into the membranous division—is, above all the rest, susceptible of modification and change of direction. The urethra has no lateral flexions, presenting neither bends nor flexuosities, but is exactly parallel with the median line. Nothing, however, is easier than to produce bends in the entire spongy region, particularly in the bulbar portion.

It should never be forgotten, in making examinations for stricture, or indeed in any urethral instrumentation, that the elasticity or distensibility of the urethra resides for the most part in the spongy portion, as is clearly demonstrated by erection; and this elasticity belongs in the greatest degree to the inferior wall, which permits of easy distention or elongation, and changes its dimensions and form with notable facility, while the superior wall yields with much more reluctance, and offers a certain resistance to all agents tending to depress or elongate it. This difference increases with age, and obtains especially in senile urethræ.

The surgical interest of all this, in its relation to the treatment of stricture, is evident, since the distensibility of the inferior wall is brought into play even by a moderate force and the surgeon cannot count on its resistance. It glides before an instrument, and cannot serve to guide it; it cannot be incised with any accuracy or precision; it lacerates or ruptures when surprised by distention; and it yields rapidly and easily to a mechanical pressure testing its distensibility. It should be noted, too, that this elongation of the canal is chiefly at the expense of the anterior urethra. Again, the spongy portion does not yield equally in all its parts, since it has been shown that of the different regions the perineo-bulbar is the most distensible. The inferior wall of the urethra can then be considered as normally longer than the superior surface. The term "surgical wall" proposed for the upper wall by Guyon would seem to be merited, because it offers the shortest route to the bladder; it is the most regular and constant as to form and direction; presents the smoothest and firmest surface; is the least capable of gliding before an instrument or of being modified by mechanical pressure; offers the greatest resistance to rupture and penetration; is less intimately connected with important structures; and is the least vascular of the two walls.

Instrumentation.—In the normal condition of the urethra the introduction of steel sounds or catheters is quite simple; in disease or injury special skill and judgment are required. It is perhaps superfluous to add that here, as elsewhere in surgery, asepsis or its synonym, perfect surgical cleanliness, is essential. Owing to the sensitiveness of the urinary tract, a certain degree of risk attends the use of strong chemical antiseptic agents; attention, therefore, must be directed to asepsis rather than antisepsis. The best means of rendering metal instruments clean is the application of heat, either by boiling in a 1 per cent. soda solution or by the use of a steam sterilizer. If these means are not at command, a rough-and-ready way is to dip the instrument in alcohol and then allow the alcohol to burn off. Immersion in carbolic acid, 1 : 20, for a sufficient length of time is entirely satisfactory for the metal instruments, but the carbolic solution must be replaced by sterilized water before the instruments are used. Recent observations would seem to show that in the case of solid polished instruments like steel sounds very brisk friction with sterilized cloths renders the surface free from micro-organisms; but the method can scarcely be relied upon; certainly it would be well to supplement this, even in office practice, by running the instrument through the flame of a spirit lamp before inserting it.

Instruments made of rubber or whalebone are soon destroyed by heat and by carbolic solutions; therefore they must be sterilized by means of other chemical antiseptics: sublimate solution in the strength of 1 : 2000 is the best. A saturated solution of boracic acid has been recommended; it is as useless as it is harmless.

As lubricants olive oil (either sterilized or carbolized) may be mentioned, and the various products of petroleum (such as liquid vaseline or cosmoline), sterilized glycerin, and boroglyceride in 25 per cent. solution; the latter is perhaps the best when local applications are to follow the introduction of the instrument. Cocaine may be combined with any of these lubricants in cases of great urethral tenderness, but, in spite of the greater freedom with which it is being used in vesico-urethral sur-

gery (see Chismore's modification of Bigelow's operation), I confess to having yet a fear of its general toxic effects, having witnessed very alarming symptoms follow a comparatively small dose *per urethram*.

Metal instruments should be always warmed to the temperature of the body before they are introduced; friction with a sterilized towel or the use of an alcohol lamp, as mentioned above, is an excellent way of taking off the chill. Attention to this precaution will often facilitate the introduction of the instrument and overcome a tendency to spasm of the urethra.

In selecting metal sounds or catheters the curve of the instrument should correspond to that of the fixed urethra.

The instrument should be passed while the patient is in a recumbent position. To secure greater relaxation of the abdominal muscles the head and shoulders may be slightly elevated and the knees a little flexed and separated. The point of the sterilized instrument is introduced at the meatus while the organ, held between the thumb and fingers of the left hand, is gently put upon the stretch and advanced upon the instrument. The position of the instrument at this time should be parallel with Poupart's ligament. The handle is then carried round to the median line, being kept close to the abdominal wall; in this position it is gently advanced toward the patient's feet, and at the same time the penis is slipped up over the shaft of the instrument until four or five inches have been passed and the further advance of the instrument seems to be impeded. If, now, the fingers of the left hand be placed upon the perineum, the curve of the instrument can be felt. The handle of the instrument should then be raised and gently carried beyond the perpendicular. It should be then taken in the left hand, and the index and middle fingers of the right hand should be placed on either side of the base of the penis, making downward pressure, while the left hand, depressing the handle, carries the point of the instrument through the membranous and prostatic urethra until the handle and protruding portion of the shaft rests in a position in the median line between the thighs of the patient and pointing toward his feet. Instruments of large size will, in the absence of stricture, generally pass into the bladder of their own weight, while instruments of small calibre are often obstructed at the triangular ligament or the bulbo-membranous junction: in this case their introduction will frequently be facilitated by guiding and supporting the curve of the instrument with the left hand placed on the perineum, as described above.

If the instrument has entered the bladder, the shaft can be rotated on its long axis, thus showing that the point is free. It will be understood, of course, that no force is to be applied. It is commonly stated that the instrument should be passed only by its own weight. This may be a somewhat extreme statement, but it is an excellent guide to bear in mind.

The instrument may be arrested at any point by a diminution in the calibre of the urethra resulting from disease or injury or from a spasm of the circular fibres or of the compressor urethræ muscle at the bulbo-membranous junction. If the arrest is due to spasm, the instrument should be kept in place for a minute or two and gently pressed against the obstruction, and the muscle will usually relax. If the handle of

the instrument be lifted too soon from its relation with the anterior abdominal wall and the penis is not pulled up on the shaft, the point of the instrument is apt to catch on the anterior surface of the subpubic ligament, above the urethral canal; or if the handle be not raised at the proper time, or if the curve of the instrument be not properly supported by the fingers on the perineum, the tip becomes buried in the loose and movable urethral floor. It is equally important to keep the instrument in the middle line to prevent lateral deviation of the point. Should either of these difficulties be encountered, the instrument is to be withdrawn partially and reintroduced. In case the point has been arrested at the triangular ligament, the curve of the instrument will be found unduly prominent in the perineum.

Urinary Fever.—This condition, known under a great variety of names (not one of which is absolutely satisfactory from a scientific standpoint), has been gradually becoming better understood with the advance of bacteriology and the increasing knowledge of the toxic effects of bacterial products. To such factors must be attributed a considerable number of the cases that have septic symptoms following urethro-vesical instrumentation. But there are others in regard to which the present evidence is conclusive and does not warrant belief in any form of sepsis. Councilman[1] says: "It is questionable whether fever may be the result of irritation of the peripheral nerves. The cases usually cited as examples of this are the fever of children during teething and the fever which sometimes follows the introduction of a catheter. It does not seem reasonable that all cases of catheterization fever should be ascribed to the introduction of bacteria or to injury of the urethra. There are numbers of cases in which the careful introduction of an aseptic catheter has been followed by a chill and fever lasting a short time. The chill may follow so shortly after the introduction of the catheter that time is not given for the increase of bacteria should any have been brought with it, and it is not probable that the pyrogenic substances produced by bacteria elsewhere are on the catheter. Nor is time given for the development of sufficient inflammation to cause fever even if an injury was produced by the catheter. In many cases a temporary increase of temperature is the only phenomenon. The case is different when fever follows the introduction of a catheter into an inflamed urethra or bladder. In regard to the question of production of fever from peripheral irritation, a strong argument against it is that it is only in certain parts of the body that such irritation is followed by fever. No irritation of the skin in general which is not followed by inflammation will produce fever. In the inflamed bladder or urethra the pyrogenic material is already present, and sufficient injury may be produced to cause its absorption."

Thorndike has systematized and described the various phenomena which may occur as the result of instrumentation upon the male urethra and bladder as follows:[2]

"1st. The cases of 'urethral shock,' brought about by the simple passage of an instrument in the urethra; very common, and as a rule of little importance, but occasionally terminating in speedy death. This fatal form is rare and generally associated with renal disease of some sort.

[1] Vol. I. of this work, p. 204.

[2] *Proc. Mass. Med. Soc.*, June, 1891.

"2d. The cases of 'acute urinary fever,' caused probably by absorption of poisonous products from the urine; this acute attack at times recurring without any known cause, such as further instrumentation.

"3d. The cases of 'chronic urinary fever,' coming on after catheterism in cases where obstructive disease had pre-existed in some form for a long time.

"4th. Cases of 'septic infection' from an unclean instrument. This may be merely a mild cystitis, may extend upward and cause septic trouble in the kidney, or may manifest itself as a true general septicæmia or pyæmia."

Thorndike continues: "It is certainly unwise to use any one term, be it 'catheter fever' or some other, to include these different sets of cases. The cases of nervous disturbance, the 'shock' cases, differ in no respect from cases of nervous shock produced in other ways. The same may be said of the septic cases. This leaves us two sets of cases to which the term 'urinary fever' may properly be applied—the acute cases and the chronic cases occurring in patients with obstructive disease. To these two classes the terms 'acute urinary fever' and 'chronic urinary fever' may be properly applied.

"1. After instrumentation upon urethra or bladder, especially if it be the patient's first experience of the sort, he becomes faint and may completely lose consciousness, or he is seized with one or more short rigors. This attack is accompanied by little or no fever, passes off in a few moments, and is, as a rule, followed by no bad result of any kind. The attack then comes on directly or very shortly after the passage of the instrument, is of short duration, and is followed by little if any constitutional disturbance. The attack is also more likely to occur, and to occur with greater violence, the deeper into the urethra the instrument is passed.

"There is, however, a severer form of shock which is fortunately much rarer. The rigor is very marked, and occurs instantly after the introduction of the instrument. It is apt to be followed in a short time by more or less complete collapse.

"There may be various other symptoms associated with the collapse in different cases—*e. g.* vomiting, diarrhœa, retention or suppression of urine—but they are all cases of this type; that is, they are all sharp attacks, coming on immediately or very shortly after instrumentation, and the fatal result comes rarely later than forty-eight hours from the beginning of the attack. There may be little or no fever, and the attack begins so soon after its cause that there has been no time for any septic absorption to take place. Again, in those cases where there has been suppression of urine death takes place so quickly that it cannot by any possibility be attributed to uræmia following the suppression. The cases are cases of shock pure and simple.

"2. A typical case of Class 2 would be the following: A patient in good general condition is examined for stricture, and a bougie or steel sound passed with little or no difficulty. After several hours, and generally shortly after the first urination following the passage of the instrument, the patient experiences a distinct chill. He looks badly, has an anxious expression, and begins to complain of pains in back and head. Temperature rises, and there may be vomiting and retention of

urine. Temperature goes higher; thirst becomes marked. This febrile attack lasts a few hours, and gives way to a period of sweating, after which the patient is left in an exhausted condition; the fever leaves him, as a rule, inside of twenty-four hours, and on the next day he has wellnigh recovered his usual good health. This usually ends the trouble, but this attack may recur one or more times without fresh provocation of any sort. This recurrence, with no further instrumentation or other assignable cause, would of course suggest further trouble of a serious nature; but attacks of this sort may go on for some weeks with many recurrences and yet end in recovery.

"3. The chronic febrile cases form a very distinct class by themselves. In them the attack follows the passage of a catheter for the relief of a more or less distended and atonied bladder. An old stricture or a gradually progressive prostatic hypertrophy has caused a long-standing obstruction to urinary outflow. The result has been a slowly but constantly increasing amount of urine retained in the bladder, so-called 'residual urine,' and a consequent long-continued distention and slowly-increasing atony of that organ. Such a case comes sooner or later to the surgeon for relief, complaining that he cannot hold his water—that it is constantly dribbling away from him. Inquiry reveals the fact that the trouble has existed and been increasing for several years, and the catheter draws off a considerable amount of residual urine. The patient is instructed as to his condition and started regularly on his catheter-life. In a few days he begins to feel poorly, has chilly feelings, but not necessarily a distinct rigor. He becomes feverish, but his fever is slight and he has distinct intermissions. He loses his appetite, suffers considerably from thirst, and feels wretchedly at all times. Tongue becomes dry and covered with a brown coating. Examination of the urine generally shows a cystitis more or less marked, even if this condition did not exist before the beginning of regular catheterism. This condition may persist for weeks, and yet the patient recover with proper care, or it may terminate fatally, in which case there will be found almost invariably advanced disease of the ureter and kidney.

"If the obstruction has been of long duration before relief was sought, there is usually a more or less marked atony of the bladder-wall and a urine of very low specific gravity, the latter suggesting the probable existence of dilated ureters with hydro- or pyonephrosis. These are the cases which terminate fatally.

"If, on the other hand, relief be sought early, the febrile disturbance will probably disappear gradually, and the patient may continue his catheter-life in comfort for years.

"4. Of the trouble which may arise as a result of direct septic infection following instrumentation upon urethra or bladder but little need be said. As the result of the passage of an unclean instrument we may get a simple cystitis, accompanied by slight if any constitutional disturbance. This may, and generally does, clear up and disappear under proper treatment. Or the septic process may extend up the ureter and cause a pyelonephritis and death from the 'surgical kidney,' so called.

"Again, we may have absorption of the septic material through a wound made by the instrument, and so a true septicæmia may begin. This may prove slight and end in recovery, or may prove speedily fatal.

Finally, as a result of purulent absorption we may have the rare complication of pyæmia with pus-formation in joints, pleuræ, etc. This proves fatal in the majority of cases."[1]

MALFORMATIONS OF THE URETHRA.

Only eight or nine cases are on record of the entire absence of the urethra, albeit a penis was present; as a cause of death in the fœtus it may be possibly not infrequent in still-born children and have escaped detection. The distention of the bladder and urachus—an inevitable result when there is no escape for the urine—would be likely to cause death from obstruction to the fœtal circulation in the seventh or eighth month of gestation. When the child lives for some time after birth the urine has usually forced an exit either through the umbilicus or through a vesical fistula. Kaufmann[2] mentions eleven cases noted by various authors, and in only one is it reported that the child was still-born. The total obliteration of the urethra and its conversion into a fibrous cord, according to the same author, has been reported but four times, included in the above number. If a fistula has not formed, the bladder should be opened and drained through a perineal wound as soon as possible, and the manufacture of a permanent urethra may be undertaken at a later date.

Certain other deformities of the urethra may be mentioned, usually associated with malformation of the penis, but they are so rare that they deserve notice merely as pathological curiosities, such as duplication of the urethra in the anterior half, the second canal ending in a blind pouch close to the pubis.[3] Complete double urethra has been reported only in cases of double penis;[4] again, absence of the bladder and urethra, with opening of the ureters into the rectum, has been reported by Chopart.[5] Entire absence of the penis, and consequently of all the penile portion of the urethra, is reported by Nélaton,[6] also by Goshler,[7] by Revolat,[8] by Chopart,[9] by Ashby and Wright,[10] and by Collier.[11]

Atresia may occur either in the anterior or posterior portion of the urethra, and may be merely membranous, or the urethra may be converted into a solid cord for a considerable portion of its extent. Atresia of only membranous thickness usually occurs close to the meatus, while cord-like obstruction is more commonly found in the membranous portion. Depaul[12] has noticed a case of this description in which the anus also was imperforate and the large intestine ended in the bladder; the penis, nevertheless, was well developed. A case is reported by Simpson[13] in which the imperforation extended throughout the prostatic urethra.

[1] Thorndike: *op. cit.* [2] *Krankheiten d. Mannl. Harnrohre u. Penis*, p. 3.
[3] Malgaigne: *Traite d'Anat. patholog.*, ii. 443; Woods, *Brit. Med. Journ.*, Sept. 19, 1891.
[4] Hirst and Piersol: *Human Monstrosities*, vol. iv.; and Demarquay: *Mal. chir. de Penis*, p. 545—two cases. [5] *Mal. des Voies urinaires*, p. 147.
[6] *Gaz. des Hôp.*, 1854, No. 12, quoted by Jacobson, *Dis. of Male Org. of Generation*, p. 610.
[7] *Vierteljahrsch. f. pract. Heilk.*, Bd. lxiii. S. 89.
[8] *Journ. de Sédilot*, t. xxvii. p. 370. [9] *Mal. des Voies urinaires*, p. 147.
[10] *Dis. of Children*, p. 351, quoted by Jacobson, p. 610.
[11] *Brit. Med. Journ.*, vol. i. p. 409, also quoted by Jacobson.
[12] *Gaz. hébdom. de Méd. et Chir.*, 1860, t. viii. p. 324, quoted by Demarquay, *op. cit.*, p. 577. [13] *Obstet. Works*, p. 173.

When there exists no striking deformity of the external genitals, the condition will most probably be made known soon after birth by the restlessness of the infant and by the distention of the abdomen; there will also be frequent efforts to evacuate the bladder, and, as imperforation of the anus is often associated with that of the penis, the tenesmus will extend to the rectum. During these straining efforts the dilatation of the urethra, owing to the accumulation of urine, indicates the point where the obstruction begins: if the urethra does not dilate at all, the obstruction is probably deep in the posterior urethra, or possibly a portion of the urethra consists merely of a fibrous cord.

Treatment.—If the atresia consists of a membranous or tegumentary septum at or close within the meatus, it should be perforated, either with a trocar and cannula or with a bistoury, and the opening dilated with a sound several times in the course of the following two or three days to keep it from closing again. If the obstruction is cord-like and extends into the deep urethra, it is probably safest to empty the bladder at once through the perineum, entering the urethra behind the obstruction if possible. After this has been done, any subsequent plastic operation to render the whole urethra pervious may be performed with comparative safety and chance of success. On several occasions success has followed, nevertheless, the introduction of a fine trocar through the meatus and pushing it in the direction of the normal urethra, thus directly penetrating the obstruction itself, instead of entering the urethra behind it, as in the former case. In two cases reported by Demarquay[1] this operation was abandoned as a failure and the child left to its fate, but in a few hours spontaneous opening of the remaining portion of the obstruction occurred and a perfectly free passage for the urine was obtained. It must, however, always be a more or less uncertain procedure, and one would imagine the chances of success in a given case of deep atresia to be but slight.

Congenital Stenosis of the Meatus Urinarius.—This condition is frequently associated with phimosis, but is usually overlooked until the necessity arises for the passage of an instrument. If the contraction is so decided that it gives rise to difficulty in micturition, or if it is the cause of reflex symptoms, the meatus must be enlarged by cutting toward the frænum with a blunt-pointed tenotome, the operation being termed "meatotomy." The incision should always make a rather larger opening than it is desired to retain, as considerable contraction follows healing. In order to keep the wound open a pledget of iodoform gauze should be inserted, and subsequently a meatus bougie should be introduced every day or every other day in order to maintain the calibre until healing is complete. Various forms of urethrotomes have been devised for this operation, but they present no advantages over the ordinary tenotome. The pain experienced from the operation is not great; this may be entirely avoided by the use of a 10 per cent. solution of cocaine applied locally a few minutes before cutting. Meatotomy is frequently required in practice among adults for the purpose of securing freer access to the deeper portions of the urethra or for the purpose of relieving reflex symptoms.

Congenital strictures of the deep portions of the urethra are ex-

[1] *Op. cit.*, pp. 582, 583.

tremely rare; unless the patient is seen in the first year and a half of life, it will be difficult to determine that the contraction may not have been acquired by disease or by injury. Kaufmann is of the opinion that the three cases reported by Guyon[1] and the four which Englisch[2] cites are all somewhat doubtful. The most trustworthy case, he thinks, is one reported by Demme,[3] in which the sufferer was only one year old and had always shown signs of difficulty in urination; the stream was exceedingly small and the abdomen at times became much distended; there were also great restlessness and attacks as of colic at night. Eclamptiform attacks caused by distention of the abdomen by delayed urination occurred toward the end of the first year. On examination the narrowing of the urethra was found to extend from the meatus to about 4.6 cm. within.

It is not probable that in congenital stricture there would be any discharge from the meatus, whereas strictures caused by traumatism or disease are preceded by an inflammatory process, accompanied by a discharge that is kept up by the irritation after the stricture is formed.

Treatment.—Gradual dilatation is to be tried first with small-sized bougies, and if this fail internal urethrotomy is necessary.

Valvular Folds.—Obstructions of the anterior urethra caused by valvular folds of the mucous membrane may occasionally simulate strictures very closely in the symptoms which they produce. They are usually situated at the boundary of the fossa navicularis, and are caused by an overgrowth of the normal valve-like fold of this region (Guerin). Their diagnosis is always difficult and often impossible, but if no obstruction be offered to the passage of a sound, and yet the flow of urine is interfered with, such a valvular condition may be inferred. When discovered the valve should be incised through an endoscope or by a urethrotome.

Diverticula of the urethra are somewhat rare congenital malformations. They generally occur on the lower surface of the penile portion of the urethra, and produce enlargements of various sizes dependent on the distention of the sac. In one case mentioned by Kaufmann[4] the sac held one pint of urine. The diagnosis is always easy, and will be established by the presence of a swelling free from inflammation or from the signs of solid neoplasm; in the distended condition light will be transmitted, and the swelling may sometimes be emptied by manipulation or by catheterization. The condition is one that can be readily relieved by introducing a grooved staff or director in the urethra and making a longitudinal incision internally on the lower surface of the diverticulum; the tissues are then cut away on either side of this incision, so that only a portion of the walls of the sac are left for the formation of a canal of normal size. The wound must then be united by two layers of sutures, one in the mucous membrane and one in the skin.

INJURIES OF THE URETHRA.

Punctured and Incised Wounds.—It is of somewhat rare occurrence,

[1] *Op. cit.* [2] *Archiv für Kinderheilk.*, Bd. ii. p. 85, 1881.
[3] *Bericht des Jenner. Kinderspitals*, 1875, p. 38. [4] *Op. cit.*, p. 15.

when the wounding instrument penetrates from the outside, that punctured wounds of the urethra are not complicated by more extensive wounds of the perineal and pelvic structures: the larger wound either hides the smaller, the urethral wound, or else the treatment of the greater includes that of the less and the puncture of the urethra escapes unnoticed. Simple punctures from within outward, caused by undue force or carelessness in the use of urethral sounds, are not so common as the former. In general these wounds of the urethra do not prove serious, and when the urine is healthy and does not escape into the tissues to any large amount, they heal readily under no other treatment than thorough cleansing and an antiseptic dressing.

Incised wounds, both those of the pendulous and of the fixed portions of the urethra, heal quite kindly after suture, although transverse wounds when sutured are apt to leave cicatricial contractions which eventually result in a stricture. In all cases a catheter should be passed, and after the urethral wound has been closed drainage should be maintained for several days to ensure against urinary infiltration, whereof the first sign is a signal for opening the wound and for giving free escape to the urine; otherwise free incisions must be made over all the infiltrated areas.

To suture the urethra a catheter must be passed beyond the urethral wound, and then the stitches carried through the coats of the urethra, but not including the mucous membrane. After the wound has been sutured the urine must be drawn off with a catheter for two or three days. The catheter must be of small size, so as to avoid stretching the wound, and must be used often enough to prevent the bladder from becoming distended, thereby forcing some of the urine to pass alongside of the catheter and cause irritation.

Laceration or rupture of the urethra in the pendulous portion is almost invariably due to violent bending of the penis during coitus or from the "breaking" of a chordee—a barbarous attempt which always results in further trouble. These wounds give rise to great pain, hemorrhage, and possibly to retention of urine. Urinary infiltration of the penis with gangrene and sloughing of the tissues is a frequent and most serious complication of these injuries, possibly causing death from sepsis. Retention caused by urethral rupture in the pendulous portion is partly reflex and partly due to the inflammatory swelling surrounding the urethra, and is therefore only temporary; it subsides with the inflammation.

Guyon has reported a case of almost complete rupture of the urethra and corpora cavernosa during coitus: the marked infiltration in this case necessitated free incision and the introduction of a self-retaining catheter.[1] Traumatic stricture is the inevitable sequence of a laceration such as this.

Laceration and rupture of the fixed portion of the urethra are caused by blows on the perineum given by a fall astride of some hard substance or by a blow on the same region while the patient is stooping. Fractures of the pelvis, or even momentary dislocation of the pubic symphysis, by crushing or stretching the urethra may cause a total or partial rupture. According to Guyon,[2] when the urethra is ruptured by a blow, it is due

[1] *Leçons clin. sur les Mal. des Voies urin.*, 1894, p. 234. [2] *Op. cit.*

to its being pressed violently against the pubic arch or the rami of the pubes. In opposition to this view, Ollier[1] contends that the urethra is usually injured at the bulbo-membranous junction; he inferred from his experiments on cadavers that the rupture was due to the tearing of the urethra over the sharp edge of the ligamentum transversum; the lesser injuries would be accordingly found on the upper urethral wall. Kaufmann is opposed to this view, since it has never been established by direct observation on the living, and the circumstances of catheterization, on which Ollier lays special stress, are very variable.

Symptoms.—There is always pain in the perineum, increased on pressure and motion. In about 75 per cent. of the cases there is retention of urine, and in the remaining 25 per cent., although urination may not be interfered with immediately, retention is apt to develop subsequently: when it develops immediately, it is apt to be only temporary. Where there is complete laceration the causes of the retention are the blood-clot and the valve-like closure of the anterior portion of the urethra; even when there is only partial rupture the hemorrhage and swelling are usually sufficient to produce retention.

There is almost invariably hemorrhage, but in some instances only a few drops of blood escape from the meatus; the amount of hemorrhage is, however, no indication of the gravity of the injury. Besides the blood which appears externally, there may be a considerable collection at the seat of the injury, or it may make its way back into the bladder; the first urine withdrawn by a catheter after the injury almost invariably contains blood.

The usual course of these injuries, it left to themselves, is, following the retention, infiltration of the contused perineal tissues, then decomposition of the urine and septic infection, extensive inflammation and suppuration. If recovery takes place, the cicatrix of the wound is sure to form a dense traumatic stricture.

Diagnosis.—Rupture of the urethra usually makes itself known by the pain and swelling in the perineum, together with the hemorrhage from the meatus and the difficulty in urination which occur shortly after the injury. These symptoms are not present at once in every case, and if the rupture has been complete, the anterior urethra may be completely cut off from the lacerated area by blood-clot or by inflammatory swelling before any blood has a chance of making its way to the meatus. In such a case simple contusion might be suspected, inasmuch as retention of urine and perineal swelling may result from a severe bruise. When no hemorrhage appears spontaneously at the meatus, a few drops of blood may be squeezed out by pressure along the urethra or by straining at urination. If during this forced urination the swelling in the perineum increases in size, urination must be stopped at once and a catheter introduced to draw off the urine. Should the passage of the catheter cause severe hemorrhage or be exceedingly difficult, the likelihood is that the rupture is complete or nearly so; and it is advisable to allow the catheter to remain until the inflammation and swelling have somewhat subsided or until other measures have been adopted to secure drainage of the bladder. If catheterization is not seriously interfered

[1] Quoted by Kaufmann, *op. cit.*, p. 122.

with and no blood appears at the meatus, it is safe to suppose that no rupture has occurred.

As to the diagnosis of the exact seat of the rupture, the following description[1] sufficiently sets forth the essential points: "The anatomical peculiarities of the part explain the usual course of urinary extravasation. The urethra may, for example, be divided into four regions. In all that part from the meatus to the scrotal curve extravasation is accompanied by a swelling and discoloration of the penis, greatest in the immediate neighborhood of the injury. In the region included between the attachment of the scrotum and the anterior part of the bulb the course of extravasated blood or urine is governed by the attachments of the deep layer of the superficial fascia or fascia of Colles. This is attached to the sides of the pubic and ischiatic rami, and behind, after dipping over the edge of the transverse perineal muscles, it is attached to the base of the triangular ligament, becoming continuous at the posterior edge of that ligament with the pelvic fascia, where it blends with the posterior layer of the triangular ligament. This fascia of Colles is continuous with the dartos-tissue of the scrotum, and extends upward to the abdomen, being attached in the middle line to the symphysis and on the outer side to the fascia lata, just beyond Poupart's ligament, leaving a space between the symphysis and the spine of the pubes, to which it is not firmly fixed; it then becomes continuous with the deep layer of the superficial fascia of the abdomen. Extravasation of urine occurring through laceration in the bulbous region of the urethra will first follow the space enclosed by this fascia in front and below, and by the anterior layer of the triangular ligament posteriorly, and, as it cannot reach the ischio-rectal space on account of the attachment of the fascia to the base of the ligament, and cannot reach the thighs on account of the insertion of the fascia into the ischio-pubic line, it is directed into the scrotal tissues, and thence up between the pubic spine and symphysis until it reaches the abdomen. I have seen cases in which, from neglect to provide an outlet for such effusions, not only the entire scrotum, but the whole of the soft parts of the lower portion of the hypogastrium had sloughed away; and such cases have frequently been recorded.

"If the injury affect the membranous urethra alone, the surrounding structures not being involved in the laceration, the extravasated urine would be confined to the region included between the layers of the triangular ligament, and would only gain access to other parts after suppuration and sloughing had given it an outlet. The consecutive symptoms would then depend upon the portion of the aponeurotic wall which first gave way.

"If the injury is situated behind the posterior layer of the triangular liagament—*i. e.* in the prostatic urethra—the urine may either follow the course of the rectum, making its appearance in the anal perineum, or, as it is only separated from the pelvis by the thin pelvic fascia, it may make its way through the latter near the pubo-prostatic ligament, where it is especially weak, and may spread rapidly through the subperitoneal connective tissue."

The **prognosis** depends largely on the extent of the injury and the timely intervention of surgical measures to prevent infiltration of urine

[1] *American Text-book of Surgery*, p. 891.

in the wound. Kaufmann gives the mortality of all cases of urethral rupture as 14.15 per cent.[1]

Treatment.—In order to systematize the treatment of ruptures of the urethra Guyon divides the cases into three classes—mild, moderate, or grave.[2] Following this classification, the mild cases are those where there are only a few drops of blood at the external meatus, pain and difficulty on urination are slight, and noticed only during the passage of the first urine after the injury; swelling may or may not be noticeable in the perineum. These cases require no energetic surgical treatment; rest in bed, light diet, local applications to allay the congestion are usually all that is required to meet the immediate needs. As soon as the wound has healed systematic dilatation of the urethra should be commenced and continued for some time. One of the chief dangers of these ruptures is the formation of traumatic stricture.

Cases of moderate severity are those where there is considerable hemorrhage from the meatus directly after the injury, pain is severe, and there is great difficulty in micturition, possibly retention for several hours after the injury; catheterization is possible, but aggravates the hemorrhage. Under these circumstances the wisest plan is to allow a soft catheter to remain in the urethra, and, if there are any signs of extravasation of urine, to make incisions in the perineum or in the scrotum as the case may be. In attempting to catheterize the patient under these conditions the point of the catheter must be made to follow the upper wall of the urethra—the "surgical wall" (Guyon); it is there that the rupture is usually incomplete, and a few shreds of mucous membrane are left to connect the two halves of the canal.

The injury is grave when hemorrhage is profuse, retention is complete, and the pain very severe; especially if in addition, there is marked swelling in the perineum at the seat of the injury, and catheterization is impossible. The retention of urine soon becomes the most urgent symptom, and must be relieved at all hazards. Suprapubic aspiration relieves the distended bladder, but it meets none of the other indications—viz. the danger of urinary extravasation, sepsis, and sloughing of the tissues; perineal urethrotomy and the introduction and retention of a catheter, bridging over the gap in the urethra, provides against urinary infiltration, but is likely to be followed by extensive traumatic stricture; furthermore, finding the deep end of the urethra is often next to an impossibility; this method is only justifiable when there is a wide separation of the portions of the urethra. Perineal incision and stitching the ends of the urethra together, without including the mucous membrane, have been found to yield the best results; infiltration of urine is thereby prevented, and, if a catheter is retained in the urethra for two or three days, there is no distention of the bladder. The external wound must be left open or drained for a day or two to provide for the escape of urine should there be any leakage between the urethral sutures. In most difficult cases, when it is impossible to find the deep end of the urethra, suprapubic cystotomy and retrograde catheterization will have to be performed. It is possible in some instances to find the deep end of the rupture by pressing down upon the bladder above the pubes and squeezing a few drops of urine through the urethra. Before making the perineal incision the exact

[1] *Deutsche Chir.*, Lief 50 A, p. 133. [2] *Mal. des Voies urin.*, 3me ed., 238.

location of the rupture should be, if possible, ascertained, and to do this a sound must be passed down to the obstruction, and the point of the instrument pressed down in the perineum; the incision should then be made over the instrument in the middle line.

Nogues,[1] quoted by Guyon,[2] has collected nineteen cases of rupture of the urethra where suturing of the walls of the canal and also of the perineal wound had been performed; he considers that this operation does not entail any great risk, and gives the most satisfactory results in many cases. It is not possible to affirm, however, in cases where there has been much contusion of the parts that a cicatricial contraction will not occur quite as dense as if there had been no suture. Erasmé[3] reports a successful operation of this nature where he stitched both the urethral wound and the wound in the perineum. The patient had no fever; almost no urine passed from the wound (not a drop after five days); in about seventeen days the wound was entirely healed; in three weeks a sound went easily into the bladder, no obstruction being felt, and the patient was discharged. It is quite obvious that this operation to be successful must be performed as soon after the injury as possible, before infiltration and sloughing have destroyed the recuperative power and vitality of the part.

After the wound has healed the urethra should be dilated with steel sounds every third or fourth day for several weeks.

Most surgeons have had cases in which it was impossible to find the proximal end of the torn urethra, and every surgeon of experience must be familiar with the long, tedious dissection which is necessary in all cases where, before the patient comes under treatment, disorganization of the perineal tissues has begun. I have said elsewhere, "If persevering and careful search fails to reveal the proximal end of the torn urethra, suprapubic cystotomy for the purpose of retrograde catheterism is justifiable, the distal end of the torn urethra being almost always easily discoverable."

Stewart[4] has made a strong plea in favor of the latter operation. He says: "The comparative advantages of the perineal and suprapubic methods of treating rupture of the urethra are overwhelming in favor of the latter—a fact which will become obvious when we consider the technique of the latter operation. The scrotum and perineum are first incised, to give vent to the extravasated urine; the incision in the perineum will enter a pocket containing bloody urine. The distended bladder is opened above the pubes by an incision just large enough to admit the index finger, which should at once feel for the vesical orifice of the urethra. A medium-sized steel sound is insinuated by the side of the finger and into the vesical orifice of the urethra; the finger should then be withdrawn from the bladder, and the sound thrust along the deep urethra until its tip appears in the perineal incision previously made for the relief of the extravasated urine. Over the projecting tip of the sound a rubber tube—or, more conveniently, a soft catheter with its blind extremity snipped off—is forcibly thrust, and the sound, carrying the catheter with it, is withdrawn from the deep urethra into the

[1] *De la Reparation de l' Urèthre perineal*, 1892.
[2] *Op. cit.*, p. 247.
[3] Quoted by White, *Boston Med. and Surg. Journ.*, Nov. 1, 1888.
[4] *Medical News*, Oct. 14, 1893.

bladder. The catheter is then detached from the tip of the sound, and the latter is passed through the anterior urethra until its tip likewise presents in the perineal incision; the end of the catheter which projects from the perineal wound is fitted over the tip of the sound, which is withdrawn from the urethra, thus threading the catheter through the entire length of the urethra, where it is retained *in situ* by thrusting a safety-pin through it and one of the lips of the meatus.

"If desired, the torn ends of the urethra may be approximated over the catheter by means of catgut sutures. The catheter should be retained in the urethra from four to six days, after which the periodic introduction of full-sized steel sounds should be practised to prevent stricture-formation."

Legueu[1] makes a useful contribution to the operative technique of retrograde catheterism. Guyon has called attention to the desirability of making the smallest possible opening in the bladder for the purpose of retrograde catheterism. As a rule, however, the bladder is but little distended, even in cases of impassable stricture, pronounced distention, rendering the bladder easily accessible, being rarely met with. It is often impossible to distend the organ, which remains concealed behind the pubes. A small incision will not permit of the easy introduction of an instrument of the usual curve into the neck of the bladder. Guyon found this difficulty in one case, and was forced to extend the wound to permit the point of the instrument to pass in front of the symphysis. After this experience, in conjunction with Faraboeuf, and after experiments upon the cadaver, he determined the particular curve necessary and constructed a "retrograde catheter." It was first employed in July, 1894, by Albarran for impassable traumatic stricture. A very small incision in the bladder sufficed, and the instrument easily engaged in the neck of the bladder and its point appeared in the perineum. The operation was completed quickly and satisfactorily. Two other operations have been performed since that time. The instrument is grooved on the inferior surface, and has at the extremity a means provided for attaching a flexible catheter.

Heretofore retrograde catheterism has been reserved for impassable stricture, either of the anterior or posterior urethra, without considering whether or not the indications were different in the two cases. In case of stricture of the urethra situated deep in the perineum it is usual to practise retrograde catheterism only when the proximal portion of the urethra cannot be found. In the majority of cases of deep stricture external perineal urethrotomy suffices. But in strictures resulting from fractures of the pelvis and situated still more deeply, the lesions are always complex, and the urethra is apt to deviate from the median line. In these cases it would be more rational to begin with retrograde catheterism than attempt the usual procedure of external urethrotomy. The deep perineal urethra may be reached by median or transverse incision. The transverse, prerectal incision gives the better exposure, but Guyon prefers the combination of the median and transverse. The incision should be carried down to, but not into, the urethra, because the incision in the urethra would then be made on the guide anterior to the stricture, making a useless breach of continuity and rendering the incision or resection of the strictured part a matter of more difficulty. If the ure-

[1] *Annales des Maladies des Organes génito-urinaires*, April, 1895.

thra is carefully laid bare, or an instrument passed through the urethra from without, and then retrograde catheterism be performed, the area of diseased urethra will be clearly manifest, the strictured area lying between the points of the two instruments. This method applies, of course, to those cases in which it has been decided to practise retrograde catheterism from the first. If it seems probable that the proximal extremity of the urethra can be found, the usual operation of external perineal urethrotomy is preferable. Whether or not the hypogastric vesical wound should be closed depends upon the condition of the bladder; if there is infection, it would be advantageous to keep the wound open for drainage; the same is true if there has been resection of the urethra followed by suture; otherwise the bladder-wound should be closed. Von Dittel[1] describes a new method of closing a fistula in which the loss of urethral tissues extends for over three-quarters of an inch and involves all but the upper walls of the urethra. He has often observed that the ordinary methods of procedure only lead to a large cicatrix and a persistent fistula, and that simple freshening of the wounded surfaces and suturnig do not produce the desired result. The following operation was performed successfully upon a urethral defect an inch to an inch and a quarter in length situated in the bulbous portion of the spongy urethra, in which the only portion of the urethra remaining was its upper wall and a portion of the side walls. The attempt had been made to heal the wound by granulations, and the fistula was surrounded by a granulating surface elliptical in form and an inch and a quarter in width at its widest portion. An incision was made on the left side of the wound through the sound skin parallel to the edge of the wound, and carried down deeply to within about a quarter of an inch of the edge of the mucous membrane. There was thus formed a movable flap having its base attached along the mucous membrane of the fistula and extending its whole length, while its free edge was covered by skin. This flap when laid over on the opposite side completely covered the granulating surfaces. The granulations were scraped off, so that two fresh wound-surfaces were opposed to each other. In order to hold these surfaces in apposition until union was complete the author introduced three silver sutures. They were passed through the base of the flap, avoiding the mucous membrane, from the depth of the fresh incision on the left side. They then passed across the fistula, entering on the right side above the mucous membrane, emerging through the sound skin of this side, thus forming a deep suture uniting the tissues superficial to the urethra. The skin-edges were further united by superficial stitches of fine silk. An iodoform gauze and sterilized gauze dressing, with a retention catheter, completed the operation.

The course of the healing was feverless: the stitches were removed on the twenty-third day, when the union was found to be perfect except for minute fistulæ at the extremities of the wound, which closed eight days later. Despite the subsequent suppurative prostatitis, the patient recovered completely, and was able to retain his urine from two to two and a half hours, and urinated with a good stream.

Guyon, in an excellent article[2] on partial resection of the perineal

[1] *Wiener klin. Woch.*, May 16, 1895.

[2] *Ann. des Mal. des Org. gén.-urin.*, May, 1892, quoted in *Sajous' Annual*, 1893.

urethra, prefers this procedure to total resection in all suitable cases, for the following reasons: 1. In most cases of traumatism and of gonorrhœal inflammation the roof of the urethra escapes in a great measure the subsequent lesions, the dense cicatrices being found in connection with the urethral floor. 2. If in such instances there is complete resection of the urethra, the elasticity of the tissues causes a much greater retraction between the resected edges of the urethra than could otherwise take place. 3. In partial resection the subsequent cicatricial contraction, in connection with the floor of the urethra, the roof not being disturbed, tends to increase rather than diminish the calibre of the urethra at that point. Although excessive separation in partial resection does not take place between the cut edges of the urethra, yet these edges are frequently too far apart to be brought together by sutures, in which conditions Guyon allows the gap to be filled up by soft tissues, as he considers an extensive cicatrix made up of such elements far better than the leaving of any inodular urethral tissue. In these cases the soft tissues between the urethra and the skin are brought into close apposition by tiers of deep sutures, a "sonde à demeure" serving to drain the bladder, the hope being to obtain union by first intention, which result Guyon has secured in several of his cases. When, however, the cut edges of the urethra can be brought into apposition, the author advises sutures, which should be inserted transversely and on the same plane, care being taken not to have them involve the mucous membrane. If much tension is brought to bear on the sutures, they easily pull out of their urethral attachments; therefore sutures should be used only in cases where there is little or no tension.

Urethritis.

The urethra, like other mucous membranes in the body, may be the seat of purulent inflammation due to a variety of causes, both primary and secondary: among the primary causes may be mentioned infection with the gonococcus, traumatism, and irritation from acrid vaginal discharges during coitus. The secondary causes are syphilis, tuberculosis, and cancer; local inflammation of the urethra and purulent discharge may be caused also by chancroid, urethral chancre, and herpes. Of these varieties, that caused by infection with the gonococcus is by far the most common, and to it is due, either directly or remotely, nine-tenths of all urethral discharges. Urethritis may be classified, as suggested by Lustgarten,[1] as infectious or non-infectious, according to the presence or absence of the specific micro-organism.

Infectious Urethritis, Blennorrhœa, Gonorrhœa, or Clap.—Of these four names for the same disease, the term "blennorrhœa" was adopted as early, or as late, as 1859.[2] Its meaning, a discharge of mucus, is as far from conveying an accurate notion of the ailment as the term "gonorrhœa," a discharge of semen, which preceded it, and which was first introduced, according to Littre, by Ambroise Paré in the sixteenth century. Were it not for the disrepute into which it has fallen, the word *clap* would be quite as good as either of these two terms, inasmuch as it is non-committal, and its age of three hundred years ought to entitle it to some degree of respectability. It is found, according to Murray's

[1] Morrow: *System of Gen.-urin. Dis.*

[2] Cf. Murray's *New Eng. Dict.*

New Eng. Dict., in the *Mirrour for Magistrates* in 1587. Unfortunately, it is banned from polite society. Under these circumstances would it not be more scientific, in the light of modern bacteriological research into the nature and causation of this disease, to abandon, as far as possible, these defective or misleading terms, and substitute the more strictly correct term "infectious urethritis"?

Definition.—Infectious urethritis is an acute contagious inflammation of the mucous membrane of the urethra, due to the invasion of the specific micro-organism—the gonococcus; it is characterized by a purulent discharge, burning during urination, and, occasionally, constitutional disturbance; it is always preceded by a period of incubation which varies from three to seven days; according to Finger,[1] "the greatest number of cases develop on the third day; a period of incubation longer than fourteen days is extremely rare." It may be either acute or chronic, and it may attack the anterior urethra alone or it may involve the posterior urethra in either an acute or a chronic form.

Etiology.—The cause of infectious urethritis is undoubtedly the direct contact with a discharge containing gonococci.

Prior to Neisser's discovery of the gonococcus numerous theories had been advanced as to the cause of urethritis. Donné in 1837 described an infusorium found in the pus of vaginitis, to which he gave the name "trichomonas vaginalis," and which he concluded was the exciting cause of gonorrhœa. Unfortunately for Donné's fame, this same infusorium was found also in the secretion of healthy vaginas. In 1868, Salisbury attributed urethritis to the presence of thread-like fungi, crypta gonorrhoica, which he found in the pus from the urethra. Neisser in 1879 reported[2] his observation of a micrococcus which was constantly found in the pus from cases of gonorrhœa; Koch's method of staining was used to observe this "gonococcus," as Neisser subsequently called it.[3] Corroborative observations soon followed, and cultivation, although unsuccessful at first, was finally attained by Bockhart,[4] who succeeded in obtaining a pure culture from which he was able to produce a typical case of specific urethritis in a healthy urethra. The victim of the inoculation, a paralytic, died of pneumonia ten days after; at the autopsy, in a section of the urethra made just behind the fossa navicularis, almost all the white blood-corpuscles which were lying loose in the transverse sections of the blood-spaces around the urethra contained gonococci. Bockhart says that the micro-organisms were always within the nuclei of the cells, and never in the cell-substance proper, and has so represented them in his drawings. Arning[5] suggests that what Bockhart held to be micro-organisms were merely particles of granular cells which had been squeezed out in the process of preparation; he disagrees entirely with Bockhart as to finding the gonococci in the nuclei alone. In this his observations coincide with more recent knowledge; gonococci are never found in the nuclei; they may occasionally overlie the nucleus and appear as if lying within it.

Following Bockhart, Bumm obtained pure cultures by using a medium

[1] *Blennorrhœa of the Sexual Organs*, p. 47.
[2] *Centralbl. für die med. Wissensch.*, xvii. 497, 1879.
[3] *Deut. med. Wochensch.*, May 13, 1882.
[4] *Vierteljahrschrift f. Dermatol. u. Syph.*, 1883, p. 3. [5] *Ibid.* p. 371.

composed in part of human blood-serum, and also confirmed them by inoculation.[1] The gonococcus will not grow on meat infusions, nutrient gelatin, or agar-agar; it must be grown on blood-serum, preferably that of human blood. Human blood-serum is most easily obtained from parturient women; after the umbilical cord has been tied and cut, the placental end may be inserted in a sterilized flask and a small quantity of blood allowed to escape. Only sufficient serum for seven or eight tubes can be obtained in this way at one time. The blood must be then set aside in a cool place for twenty-four hours until the clot has separated and the serum has risen to the top; sufficient quantity of the serum is then drawn up in a sterilized pipette and run off into the test-tubes. In order to solidify the serum the tubes are then placed on a slant in an oven which can be kept up to a temperature of not less than 70° C. (158° F.), and should remain in this oven until the serum is completely solidified.

When inoculating the tubes it is best not to smear the pus over the surface of the serum, but to touch it lightly here and there, leaving little drops of pus from which colonies may start. The tubes should then be placed in a jar containing a little distilled sterilized water, in order to supply a somewhat moist atmosphere favorable to the growth of the gonococcus; the jar and tubes should then be put in the incubator and kept up to a temperature of 30–37° C. (85° to 95° F.). The growth of the gonococcus manifests itself as a thin, transparent film over the serum, at first scarcely visible to the naked eye, and very slow to increase. Bumm recommends, owing to the brief vitality of the micro-organism under cultivation, that a fresh inoculation should be made at the end of eighteen or twenty-four hours. According to Sternberg,[2] the micro-organism will not grow at a temperature below 25° nor above 38° C., and he says that a temperature of 60° C. maintained for ten minutes absolutely destroys the virulence of the pus.

The pus for cultivation must never be taken from the exterior of the meatus, but should come from the interior of the urethra; the meatus urinarius should be wiped off with a solution of bichloride, and then a drop of pus squeezed from the deeper parts of the urethra, or else the platinum needle should be inserted in the urethra and a drop of pus obtained from the region of the fossa navicularis or posterior to it. If these precautions are not taken, the culture is apt to be spoiled by the development of numerous other rapidly-growing bacteria which will entirely overgrow the gonococcus.

While, as has been said, the gonococcus has never been cultivated on gelatin or agar nor in meat infusions, yet in many cases inoculations on these media produce a growth of diplococci closely resembling the gonococcus in shape and staining properties, but which are slightly larger than the specific micro-organism. Frequent attempts have been made to reproduce a specific urethritis with these "pseudo-gonococci," as they are called, but never with success. Neisser affirms[3] that whatsoever it may be that grows upon the media above mentioned, it is not the gonococcus.

Microscopic Examination of the Pus.—In preparing a slide for

[1] *Der Micro-organ. der gonorrh. Schleimhaut Erkrankungen*, 1885, quoted by v. Jaksch, *Clin. Diagnosis*.

[2] *Manual of Bacteriology*, p. 286.

[3] *Verhandl. der Deutschen Dermat. Gesell.*, 1889, p. 146.

microscopic examination precaution against contamination with other micro-organisms is not of so much importance as when the pus is to be used for cultivation. Under the microscope the non-pathogenic micro-organisms are always distinguishable; they never invade the pus-cells, but are seen in the intercellular spaces.

A small quantity of the pus is sufficient: it should be smeared in a thin layer on a cover-glass and allowed to dry in the air, and when dry it should be passed three times through the flame of an alcohol lamp or a Bunsen burner in order to fix it on the glass; if it is passed through the flame before it is dry, the pus-cells are apt to shrivel and become granular in appearance. In order to stain the micro-organisms various methods of staining and counter-staining are employed: the simplest and perhaps one of the most commonly used is Löffler's alkaline methylene-blue solution, composed of saturated alcoholic solution of methylene-blue 30 parts, and of a 1:10,000 solution of potassium hydrate 100 parts. A drop or two of this solution is put on the dried pus on the cover-glass and allowed to stay there for three or four minutes; it is then washed off, and if the slide is to be used merely for clinical demonstration, the cover-glass is turned face downward on the slide and the superabundant water is dried off with bibulus-paper. In a specimen prepared in this way the pus-cells are stained a light blue, and the nuclei and the gonococci are stained very deeply. Another staining method consists in covering the pus, smeared and dried on the cover-glass, with an alcoholic solution of eosin, and then heating it for a minute or so; the excess of the dye is then removed with bibulus-paper and the cover-glass covered with a concentrated alcoholic solution of methylene-blue for fifteen or twenty seconds. By this staining the gonococci appear dark blue, the nuclei of the pus-cells a light blue, and the cell-protoplasm a light pink.

The gonococcus is decolorized by Gram's method; that is, after the pus has been stained with one of the aniline stains it is placed in a solution composed of iodine 1 part, potassium iodide 2 parts, and distilled water 300 parts; this solution generally removes the stain from the tissues, but leaves micro-organisms as originally stained; in the case of the gonococcus, however, the stain is removed. This action under Gram's stain was thought to be of great diagnostic value by Roux,[1] who first applied it to the gonococcus; but Bumm[2] maintains that this decolorization is of little diagnostic value; there are other micrococci in "gonorrhœal" pus which also are decolorized by Gram's method. Finger,[3] however, asserts that while the gonococcus is completely decolorized, these other micrococci, four varieties in all, still show some color after Gram's method; the two more frequent forms retain a milky-white and an orange-yellow color, and the two rarer forms are grayish-white and citron-yellow after decolorization.

The most important diagnostic feature of the gonococcus is that it is always within the pus-cell or closely adherent to the surface of the epithelial cells which are discharged during the invasion and decline of the disease, and is never found free in the cellular interspaces.

[1] *Le Concours médical*, Nov. 13, 1886; Keyes: *Genito-urinary Dis.*, p. 58.
[2] Quoted by Finger, *op. cit.*, p. 18, reference not given.
[3] *Loc. cit.*

Gonococci when stained appear as almost circular dots in clusters round the nuclei and scattered through the protoplasm of the pus-cells. Under a high magnifying power they appear to be somewhat semilunar in shape, always in pairs, with the flattened edges opposed. They multiply by the simultaneous division of each apparent half; therefore every cluster will be found to contain an even number of micro-organisms, unless perchance during the preparation of the specimen the pus-cells have been crushed and some of them have been squeezed out into the interspaces.

The Course and Symptoms of Acute Anterior Infectious Urethritis.—In order to consider the subject systematically it will be found convenient to divide the course and symptoms of infectious urethritis into five periods, in accordance with the time of the appearance of certain symptoms and their severity: these five periods are—(1) the period of *incubation;* (2) the *prodromal* period; (3) the *inflammatory* period; (4) the *stationary* period; and (5) the period of *subsidence*. These periods are, however, not sharply limited; one merges almost imperceptibly into the other.

(1) The duration of the incubation, in general terms, may be said to extend over an interval of three to five days from the time of infection to the appearance of the first symptom. The length of this period is, however, variable; it depends, apparently, somewhat upon the condition of the mucous membrane at the time of infection, and also somewhat upon the amount of infectious pus introduced; this can only be estimated by the number of contacts. The incubation after a first attack is usually quite short, possibly only twenty-four hours, and occasionally patients affirm that two or more weeks have elapsed between the exposure and the first symptom. These extremes of duration of the incubation are, however, always to be doubted: the patients' statements as to the date of the suspicious exposure are not trustworthy. As before said, an incubation lasting over two weeks is very rare, but is more likely to occur in patients who have suffered from previous attacks of the disease.

The action of the gonococcus on the mucous membrane partakes, possibly, more of the nature of a mechanical irritation than of a direct toxic influence on the cell-protoplasm; therefore before decided symptoms arise the gonococci must have a period for growth and multiplication, Finger states[1] that when he produced specific urethritis artificially by inoculation with pus containing gonococci, the period of incubation always varied from two to three days.

(2) The *prodromal* period is of short duration, and may escape notice entirely in hardened patients, but the penitent whose suspicions are on the alert usually notices at the end of the fourth or fifth day a slight redness and eversion of the edges of the meatus urinarius, and also a slight itching in that region; on urination there is, perhaps, a tingling or burning sensation as the first drops of urine pass over the mucous membrane. There may be also a general feeling of malaise, and possibly a little fever. These symptoms increase rapidly in intensity, and with the appearance of the purulent discharge from the meatus this period merges into—

[1] *Blennorrhœa of the Sexual Organs*, p. 47.

(3) The *inflammatory* period. At this stage there is a profuse discharge, at first rather thin, finally thick and creamy, containing gonococci in abundance; the meatus soon becomes swollen, and perhaps the whole glans may appear puffed and œdematous. The passage of urine causes acute pain and burning at the head of the penis, both at the beginning and end of the act of urination. This *ardor urinæ*, as it is called, is possibly in part due to the distention of the inflamed urethra, and in part due to the passage of the urine over the inflamed mucous membrane, which, in the neighborhood of the meatus and fossa navicularis, is most intensely congested in the early stage of the disease.

Chordee, or painful erection of the penis, is in some degree generally present; it is due to the extension of the inflammation from the submucous layer of the urethra into the trabeculæ of the erectile tissue of the corpus spongiosum; the intertrabecular spaces become blocked with lymph, and this portion of the penis is prevented from expanding to the same degree as the corpora cavernosa; consequently, when the organ becomes erect the urethra, which is bound down by inflammation, and the corpus spongiosum, which is blocked with lymph, are put on a stretch and cause the penis to bend downward when it becomes erect. Chordee may occur at any time during the twenty-four hours; it is, however, much more often troublesome at night. The stretching of the urethra occasionally gives rise to minute ruptures of the mucous membrane and the escape of a drop or two of blood, enough to tinge the pus quite deeply.

Frequent urination is another troublesome symptom which usually makes its appearance at this time. It is caused by the reflex irritation from the inflammation at or near the meatus; furthermore, the neck of the bladder seems to be abnormally irritable, although it is extremely unlikely that the inflammation has, at this early stage, extended back far enough to affect the sphincter directly. Guyon affirms, according to Finger,[1] that a typical urethritis is limited to the pars cavernosa, and that the spread of the disease to the deep urethra is always to be considered as a complication not belonging to a typical case. Finger expresses himself as convinced of the truth of this view.

(4) When the inflammatory period has lasted from four days to a week, the severity of the symptoms rapidly diminishes; the ardor urinæ and frequency of urination are no longer troublesome symptoms, but the discharge is still profuse, and is perhaps a little thicker, and possibly has more of a greenish tinge than in the first week of the disease. Painful erections (chordee) are the most annoying feature of this fourth or *stationary* period of the disease; they are not so painful as at first, although they may be more frequent. Sexual excitement is always a marked symptom throughout the course of infectious urethritis, and any passing impure thought provokes an erection which may last for hours.

If the pus be examined microscopically at this stage, it will be found to be composed almost entirely of polynuclear pus-cells, the greater number of which contain gonococci in dense clusters; only very few epithelial cells are to be seen. From this fact a tolerably accurate estimate of the duration of the disease is possible in the general run of cases.

(5) At about the end of the second week the severity of all the symp-

[1] *Op. cit.*, p. 45.

toms begins to lessen, and the fifth period, or that of *subsidence*, ensues. There is no longer the intense sexual excitement, and the tendency to chordee is no longer marked; the pulse becomes thin and scanty, and the urine is passed normally and without pain.

On examination the pus contains, besides the gonococci-bearing pus-cells, numerous epithelial cells from the mucous membrane of the urethra; in this respect it is similar to that of the third stage. The discharge, which now can hardly be called profuse, is most in the morning; generally it is no more than a drop, which to be seen must be squeezed out before the first urine is passed; the meatus is, however, usually found closed with a little dried and tenacious pus whenever, through the day, the urine is passed. This final period of infectious urethritis lasts, in uncomplicated cases, about two weeks and a half before the discharge stops entirely and the urethra returns to its former state of health. Albeit the discharge has entirely stopped, there is nevertheless considerable likelihood that any excess of drinking or of sexual excitement will at once provoke its return.

The above five periods constitute the course of a typical uncomplicated case of acute anterior infectious urethritis: cases of this typical regularity are seldom seen.

The first two periods as here described must be considered as part of the course of the disease, although they are very rarely observed clinically: the surgeon usually does not see the case until the third, or inflammatory period, is well established. Thus, the duration of the disease may be said, roughly, to be from five to six weeks; from the onset of symptoms until the inflammation is at its height is usually about a week or ten days; the stationary period then lasts from ten days to two weeks; and from the beginning of subsidence until the discharge has entirely ceased is from fourteen to eighteen days more. The complications which may arise in the inflammatory stage—namely, balanitis, balano-posthitis, phimosis, and paraphimosis, all of which will be discussed later—do not, as a rule, increase the duration of the disease; complications, however, which are associated with the last two periods invariably do increase the severity and duration.

Acute Posterior Urethritis.—During the latter part of the stationary period of anterior urethritis the course and symptoms of the disease may be materially affected by the extension of the inflammation to the membranous and prostatic portions of the urethra. This complication is of such frequent occurrence that, in the opinion of several authorities, it is considered to be a necessary termination of every infectious urethritis.

The view of Guyon and Finger, that it is a complication, is strongly opposed by recent writers. Goldenberg[1] abstracts some valuable papers on this subject, especially one by Róna.[2] The latter has observed in 200 patients who had never had any urethral trouble before, and in whom the gonorrhœa was not over two months old, the following conditions: of 47 patients who were seen in the first week, 37 had "urethritis totalis" (83 per cent.); the same condition existed in 64 out of 74 observed in the second week (87 per cent.), in 29 out of 30 observed in the third week (97 per cent.), and in 48 out of 49 who were observed in

[1] *Journ. Cut. and Gen.-urin. Dis.*, Dec., 1894. [2] *Hungarian Archives of Medicine.*

the fourth and eighth weeks (98 per cent.). In none of these cases had a sound or any other instrument been used. Only 3 of the 180 patients who had a urethritis posterior had constitutional disturbances, and in nearly all of the cases an injurious effect of occupation or of excess *in baccho et venere* could be excluded. It is interesting to note that of 39 patients who presented themselves with a urethritis posterior in the first week after infection, only 1 had been treated internally; the balance had had no treatment at all; of 64 in the second week, 11 had injections, 3 internal treatment, 50 no treatment. On the other hand, of the 13 patients who had urethritis anterior, only 9 had used injections, and yet they had no affection of the posterior urethra.

Goldenberg adds: "We all know that the gonococcus penetrates the deeper tissues of the mucous membrane at an early stage of the gonorrhœa. It has been proven that the propagation is not only one *per continuitatem*, but—and that seems to be the more common way—through the lymph-channels.

Therefore the theory that the cut-off muscle, although it forms anatomically and physiologically a sharp border between the two parts of the urethra, should prevent the gonorrhœa from spreading into the membranous part, is untenable.

Finger has claimed that the gonorrhœa stops in front of the pars membranacea because the latter is sparsely supplied with follicles and lacunæ and is less vascularized than the penile urethra, in a similar manner as sycosis, for instance, stops at the border of the hairs where there are no follicles. A plausible theory, but a mere theory at best.

Lewis[1] says: "Letzel asserts that of 53 cases of primary gonorrhœa under his care, the posterior urethra remained unaffected in only 4 cases, making the frequency of posterior urethritis 92.5 per cent. in this series;[2] Jadassohn[3] found posterior urethritis in 143 of 163 cases of gonorrhœa, thus making 87.7 per cent.; Róna[4] declares that it was proved to be present in 79.7 per cent. of his cases; Eraud found it present in 80 per cent. of all (acute and chronic) of his cases.

Ground for belief in the surpassing frequency of posterior urethritis seems, then, to be established, and it remains to harmonize this fact of frequency with the reason for frequency, since that is certainly not done by any of the teaching alluded to. Bearing on this point, the time and mode of infection of the posterior urethra are important. We have been taught that the mode is by continuity of tissue, the inflammatory process travelling over the surface of the urethral mucous membrane, gradually approaching the cut-off muscle, which it reaches and passes (if the posterior portion becomes affected) about the third week.

Again, I would submit the practical teachings of the clinic as confuting the teachings of the text-book; for I have repeatedly observed the proof of the setting-up of posterior inflammation long before the time scheduled for its usual appearance. Róna[5] says that in the cases which he watched, instead of its awaiting the third week of the disease, posterior

[1] *Medical Record*, July, 1893.
[2] *Int. Cent. für Physiol. und Path. der Harn. und Sexual-Organe*, Bd. ii. H. 6, 1890.
[3] "Beitrage zur lehre der Urethritis posterior," *Verhandlungen der Deutschen Dermatolog. Gesellschaft*, Wien, 1889, Braumueller.
[4] *Pester medizinische-chirurgische Presse*, No. 35, 1892. [5] *Ibid.*

inflammation made its appearance in the first (active) week in 82.9 per cent. of the cases in which the posterior portion became involved; and Heissler[1] asserts that in 20 per cent. the prostatic urethra becomes affected in the course of the first week; in 34 per cent. in the course of the second week; in 14 per cent. in the course of the third week; in 20 per cent. in the fourth week; in 4 per cent. in the sixth and seventh weeks; and in 2 per cent. in the second and third months.

These records do not bear out the claim for the gradual progression of the inflammation by continuity to the posterior urethra, but they argue forcibly for the correctness of the theory of Horteloup,[2] that "the infection is accomplished through the deep lymphatic ducts leading from the anterior to and through the posterior urethral membrane, emptying into the pelvic (internal iliac) glands (McClellan, Gray). If this be really so, it will explain satisfactorily the practical invariability with which the posterior urethra becomes involved, as determined by scrutinizing clinical examinations; it renders plain the small amount of influence played in this regard by the cut-off muscle or the forced injection or the alleged passage of instruments, sexual intercourse, etc. These have been uselessly, as well as unwarrantably, invoked to account for the complication that is no complication, but is merely one of the phenomena of the disease."

Tilden Brown, on the other hand, says:[3] "Some advocate the theory that the auto-infective agent of gonorrhœa is conveyed from the anterior urethra to the posterior and to all other situations—joints, aponeurotic tissues, endocardium, and epididymes—by way of the lymph-channels, and that this metastasis may occur at any time during the existence of an anterior urethritis; maintaining also that because of the firm muscular interposition of the pars membranacea an impassable barrier exists to the extension of the disease by continuity to the posterior chamber of the urethra. If gonococci do reach and cause inflammatory processes of these very distant organs, there seems to be no reason to doubt the efficacy of the lymphatics as suitable channels; but in the case of the posterior urethra I think most observers are inclined to believe that the disease traverses by continuity. At all events, it is a common clinical experience to note that at the acme of an anterior urethritis, generally some time between the sixteenth and twenty-sixth day of the disease, an extension to the posterior urethra takes place. Perhaps during this time the disease has been extending by continuity from the meatus to the bulb, and, having reached this distensible sac, which, despite an immediately preceding urination, acts as a trap to restrain some of the gonococci-laden pus, then the succeeding injection may be able to implant them in a favorable position for backward extension. Possibly some unconscious pressure of the clothing when the bulbous urethra is filled with pus, or the assuming of some sitting posture, which produces a backward pressure upon the contents of the canal at this point, may give rise to the extension. At all events, we know that persons following particular trades, occupations, or sports are especially prone to encounter this complication; *e. g.* the locomotive engineer, the cavalryman, the exercising groom, the tailor, the rower, and the bicyclist. Whether this liabil-

[1] *Pester medizinische-chirurgische Presse*, 1891. [2] *Leçons sur Urèthrite chronique*, 1892.
[3] *Am. Med. Surg. Bull.*, April 15, 1894.

ity exists on account of the increased circulatory activity of the perineal region because of passive exercise, such as the rider gives the parts, or because of the backward pressure of the contents of the bulb, or because of both of these tendencies, I am not prepared to express an opinion.

"Posterior urethritis most frequently develops, as aforesaid, about the end of the third week, but it is also easily started in the earliest stage of the suppurative process by inoculation with the pus from the anterior urethra, forced back by non-antiseptic injections or by the introduction of urethral instruments. It also not infrequently occurs in the very last stages of the anterior inflammation; in this case it is usually the result of an indiscretion on the part of the patient, either in the form of sexual excitement or of the use of alcohol, or possibly of excessive exertion."

Symptoms.—Posterior urethritis manifests itself by a diminution in the urethral discharge, a feeling of distention and burning in the perineum, and by a marked increase in the frequency of urination. The last-named symptom is the most characteristic; the desire to empty the bladder occurs at very short intervals, possibly every fifteen minutes or half hour, and, what is even more distressing, is the inability on the part of the patient to restrain the impulse to urinate. No sooner do the first drops of urine penetrate to the prostatic urethra than the desire to urinate becomes urgent in the extreme and uncontrollable. Brewer[1] cites a case where the urine was passed by involuntary effort every two or three minutes, accompanied by the most excruciating pain and marked hemorrhage. It is not unusual to see a few drops of blood follow the last drops of urine: this is caused by the action of the compressor urethræ, which squeezes the membranous urethra at the close of micturition. The congestion of the prostatic urethra produces an almost constant sexual excitation, and erections of the penis, prolonged but not painful, are common occurrences; they are very often accompanied by painful nocturnal pollutions, which have a decidedly bad effect both upon the prostatic urethra and also upon the mind of the patient; according to Finger,[2] they are caused by the inflammatory irritation of the caput gallinaginis, and frequent pollutions in the third or fourth week of urethritis are almost pathognomonic of implication of the pars posterior. Finger also states that albuminuria is almost always associated with posterior urethritis; the frequent acts of urination constantly dam up the urine in the ureters, and this in turn produces a congestion of the kidneys which leads to albuminuria. It subsides at the same time with the tenesmus.

When the urine is passed in two glasses both portions will be found to be cloudy and contain shreds of mucus and pus. When these shreds of the second portion are stained and examined microscopically, numerous gonococci will be found.

The development of posterior urethritis is apt to prolong the disease greatly; not only are other serious complications—such as prostatitis, epididymitis, cystitis, etc.—more likely to occur when the inflammation becomes deeply seated, but the disease is also more liable to become chronic.

[1] *Morrow's System of Genito-urinary Diseases*, p. 167. [2] *Op. cit.*

Diagnosis of Infectious Urethritis.—The only means of ascertaining whether or not a purulent discharge from the urethra is infectious is by a microscopical examination; the presence or absence of the specific micro-organism in several preparations of the pus at once decides the question. After a little practice there is no difficulty in distinguishing the micro-organisms which are non-pathogenic and frequently contaminate the pus from the urethra. There are three distinctive characteristics of true gonococci—namely, that they are always contained within the cells; they are always arranged in groups, never in chains; and they are decolorized by Gram's method. Another fact, aside from the microscopic examination, that will often be of assistance in forming a diagnosis is that an irritative or non-infectious urethritis is seldom preceded by a period of incubation; it begins within a few hours after the irritating substance has been introduced.

In order to determine to what extent the disease has penetrated the urethra the patient must pass his urine in two separate portions: when the first portion alone is cloudy, the inflammation has penetrated no farther than the anterior urethra; if both portions are cloudy and contain pus, then the probability is that the posterior urethra also is affected. One of the best methods of determining whether both the anterior and posterior portions are involved, or whether only one alone is infected, is that adopted by Finger, Jadassohn, and others: After the patient has held his water for several hours a soft catheter is passed as far as the bulb of the urethra, and the anterior urethra thoroughly washed out either with distilled water or boracic-acid solution; if after this irrigation the urine passed is still cloudy, then the posterior urethra is surely affected, but if it is perfectly clear, then only anterior urethritis is present.

The best time to apply the two-glass test is in the morning, when the urethra has not been washed out by the urine for some time. When the urine is passed frequently the two-glass test is deceptive; both portions of urine will be clear, although a considerable degree of urethritis exist. This fact, however, becomes of diagnostic importance when there is a suspicion of cystitis: in this disease both portions are constantly cloudy and contain pus.

Goldenberg[1] discusses at length the reliability of the two-glass test and its modifications. The method which he has used for seven years he has now improved upon by dispensing with the catheter. He says: "The irrigation, as I now practise it, is done by means of a short hard-rubber or glass tube which is attached to the irrigator. This tube is introduced up to the fossa navicularis or farther, and withdrawn a short distance; this manœuvre slightly distends the urethra at the time; the meatus is, however, not kept closed. The manipulation can easily be carried out in a few minutes, so that it may even be employed in dispensary practice. The irrigation, not being painful, can safely be practised in acute cases, but I admit that in gonorrhœa of a few days' duration it is not absolutely necessary to irrigate the urethra for diagnostic purposes. Here the simple Thompson test will be sufficient, provided that the patient has not urinated for three or four hours.

"It is not difficult to explain why in using the catheter the Thompson test with irrigation shows itself somewhat unreliable. The mucous mem-

[1] *Loc. cit.*

brane contracts about the eye of the instrument; the liquid forms a whirl directed toward the bladder; its reflux is obstructed, and the m. compressor relaxes, so that part of the liquid which is used for irrigation enters the posterior urethra and eventually the bladder.

"That the flushing of the anterior urethra without the use of the catheter is sufficient to cleanse it of the products of inflammation was demonstrated by first irrigating the canal without, and then with, a catheter on the same subject, at the same sitting, and at the same height of the irrigator. It was found that when the irrigation with the catheter was continued until the liquid came out clear, the subsequent cleansing with the catheter did not reveal any filaments in the fluid which was collected in a glass.

"From the foregoing experience, based upon an analysis of one hundred cases, I consider the modified Thompson test a faultless and practical means of demonstrating which part of the urethra is affected—a method which can be easily carried out without any inconvenience to the patient."

Treatment.—The number of remedies which have been recommended is legion, and an attempt at enumeration is beyond the scope of the present work. From the undoubtedly specific nature of the disease it would appear that the direct application of antiseptics to the mucous membrane of the urethra must be the most effective, and at the same time the most rapid, method of destroying the gonococci and limiting the disease. This is undoubtedly applicable in a certain number of cases, but as a routine treatment in the early stage when the inflammation is intense and the secretion is profuse is still somewhat *sub judice.*

In general, the treatment of acute urethritis must be of three kinds —namely, *hygienic*, *internal*, and *local*. The extent to which any one of these measures is applicable depends mainly upon the stage or intensity of the disease when presented for treatment. In almost every case, no matter what the stage, certain hygienic precautions are advisable. The irritation produced by motion, friction, gravitation of blood to the part, should be avoided, as far as possible, by rest in a recumbent position; physical exertion should also be avoided, as well as everything which tends to increase sexual impulses. The diet must be of the simplest, and the more closely it can be restricted to skimmed milk, the better; a little bread and butter and plain boiled or mashed potatoes may be added to the dietary if the milk is distasteful to the patient; highly-seasoned and greasy food must inflexibly be avoided. This part of the treatment, although of great importance, is seldom carried out; in the majority of cases the patients do not feel ill enough to make them at all abstemious, and then, again, they do not wish to divulge their plight by any deviation from their usual habits.

Diet exerts a decidedly beneficial effect upon the painful symptoms of the inflammatory period, but no detail of it is of such paramount importance as the total abstinence from all alcoholic drinks; Finger, however, states that with men to whom total abstinence is next to impossible it is his custom, rather than have them take occasional drinks, to allow them from the start a daily moderate amount of light red wine: the bad effects are slight, he thinks, if the patient accustoms his "clap" from the start to moderate amounts of alcohol and does not exceed the

prescribed amount. If the patient must be up and about, he should always wear a suspensory bandage to protect his genitals from undue motion and friction. In adjusting the bandage the testicles must be firmly supported, but at the same time the edge of the bandage must not press against the urethra too tightly, lest it close the canal and dam up the pus, thereby greatly increasing the chances for the development of posterior urethritis.

In acute infectious anterior urethritis during the inflammatory period the chief object in the administration of internal remedies is to subdue the ardor urinæ and the tendency to chordee. The smarting and burning of the urine are due, as has already been mentioned, in great part to the contact of the salts of the urine with the inflamed mucous membrane; therefore, to render the urine bland and unirritating some mild alkaline diuretic should be administered. Potassium citrate is one of the best, given in ten- to twenty-grain doses, preferably after meals. When there is considerable vesical irritation 5 to 10 drops of the tincture of hyoscyamus or of the tincture of belladonna may be added to each dose of the potassium citrate with good effect. Occasionally potassium bromide will be found equally efficient, administered in twenty-grain doses. The oleoresin of cubebs, the balsam of copaiba, and either salol or boric acid will be also found of the greatest benefit, not only rendering the urine bland, but having a decided effect upon the secretion: these remedies act best when given in combination in a capsule. An occasional contraindication to the administration of copaiba is the tendency it has in some cases to produce indigestion and even severe gastro-intestinal catarrh. Some patients have an idiosyncrasy against the drug, and become covered with a roseola or papular erythema after only a single dose. This eruption soon passes off and is of small moment, provided there is no disturbance of the digestion; as soon as the administration of the copaiba is stopped these symptoms usually cease of themselves.

I have elsewhere[1] expressed my views as to the value of salol in the treatment of urethritis. My attention had been attracted to the subject by an article in the *Gazette hébdomadaire de Médecine et de Chirurgie* (Jan. 4 and 11, 1890) by M. Ferdinand Dreyfous on "Antisepsis of the Urinary Organs by the Internal Administration of Remedies." His paper contained the results of his observations in seven cases of gonorrhœa in which salol had been administered in full doses, both with and without admixture with cubebs and copaiba.

Sahli[2] had shown that the resultants of the intestinal decomposition of salol are salicylin and carbolic acid, which are eliminated by the kidneys. He had exposed to the air for some weeks the urine of a patient under the influence of salol without the least decomposition occurring. Nencki had made the same observations. Bouchard[3] had called attention to the value of the simultaneous administration of several antiseptics. Ernest Lane[4] gave his results in 50 cases of gonorrhœa in which he used salol in doses varying from five to thirty grains, three times daily, showing that 6 were cured, 25 showed considerable improvement, 15 were unaffected by the treatment, and in 4 the symptoms were aggra-

[1] *Medical News*, June 14, 1890. [2] *La Semaine médicale*, April 7, 1886.
[3] *Thérapeutique des Maladies infectieuses; Antisepsie*, 1889, p. 247.
[4] *Lancet*, March 22, 1890.

vated. When he gave 20 grains three times daily, and relied upon its internal administration without the assistance of injections, he noticed an improvement in 20 out of 40 cases within a week, and 6 were cured completely in that time. I was then led to use the drug largely, and have usually given it in a capsule in combination with copaiba and cubebs. The exact formula is as follows: Salol 5 gr., oleoresin of cubebs 5 gr., Para balsam of copaiba 10 gr., pepsin 1 gr. While I do not think that "complete cures" are often obtained by internal remedies alone, I have become entirely convinced that the administration of this capsule is of great benefit in reducing both the severity and the duration of infectious urethritis, and in lessening the frequency of occurrence of posterior urethritis and its complications.

In addition to these remedies the patient may find great relief if he immerses his penis in quite hot water just before urinating, and then passes his urine directly into the hot water; by this means a temporary distention of the superficial blood-vessels is induced and the swollen and congested mucous membrane is thereby relieved.

As a prophylaxis in the treatment of chordee it is of the utmost importance that the bowels should be emptied just before the patient goes to bed; in addition to this, the sleeping room must be cool and the covering light. As an internal remedy there is nothing better than the bromide of potassium; it acts not only as an anaphrodisiac, but also as an arterial sedative and as an alkali. It should be given throughout the day at intervals of three or four hours until it causes distinct drowsiness; if the chordee is very severe, ten or fifteen drops of the tincture of belladonna may be combined with the last dose of bromide before the patient goes to bed. An opium suppository would be most useful were it not for its tendency to produce constipation; when it is carefully guarded by laxatives it may be administered in the following form with decided benefit:

℞. Pulv. opii, gr. vj;
Pulv. camphoræ, gr. xviij;
Ol. theobromæ, q. s.—M.
Ft. suppositoria No. vj.
Sig. Use one at bedtime.

If all these means fail, and from the violence of the chordee there is grave danger of urethral rupture and the subsequent formation of stricture, then the withdrawal of eight or ten ounces of blood from the perineum by means of leeches will be found useful; for two or three days after this the patient must remain in bed with the hips slightly elevated. This remedy is the last resort and should never be practised except on robust patients.

Local treatment consists either of simple injection or of prolonged irrigation. In regard to the time when urethral medication should be begun there is considerable variance of opinion; it is urged that urethral injections should never be given during the inflammatory stage of the disease; and, on the other hand, the earliest possible injections are recommended in order to attack the gonococci before they have invaded the mucous membrane deeply. The opposition to early injections is

based upon the supposition that the mucous membrane, already hypersensitive and inflamed, will be additionally irritated, and that any injection which is too weak to irritate will be too weak to exert any influence upon the gonococci; furthermore, it will be likely to push the infection into the deep urethra. Finger,[1] after having tried both the abortive and the later injections, concludes that, although the disease runs a milder course under the abortive treatment, it is nevertheless more protracted, and that gonococci and leucocytes remain longer in the secretion than when the injections are postponed until the acute inflammatory symptoms have somewhat subsided. In opposition to this, Neisser (quoted by Finger) maintains that the best results will be obtained by the earliest possible injection of nitrate of silver in 1 : 3000 or 1 : 1000 solution—that this shortens the course and ameliorates the intensity of the acute symptoms. With two such eminent authorities directly at variance the conclusions are either that the treatment was not begun by both investigators at the same stage of the disease, or that the patients were not treated under the same conditions in both cases. There is always a marked difference in the rapidity of cure in favor of those patients who remain under the constant supervision of hospital attendants, and to whom the treatment is administered at regular and frequent intervals, and against those to whom their own treatment is entrusted. As a general rule, therefore, it may be stated that unless the patient can be kept under constant observation and all injections administered by the surgeon, the abortive treatment is inadvisable—nay, often dangerous; but when the acme of the inflammation has been reached and the symptoms are beginning to subside in intensity, then the patient himself may be trusted with the administration of the injection.

In the beginning of the stationary period, when injections are usually begun, the inflammation, although it may extend back two or three inches in the urethra, is nevertheless chiefly centred around the fossa navicularis: the point of the syringe should, therefore, be so shaped that it does not penetrate so far as to increase the irritation. It is perhaps superfluous to add that the injection should be always given with gentleness and always after the patient has passed his urine. In order to prevent the injection from going too far back in the urethra, the patient should sit upon a towel so folded that it presses on the urethra in the perineum; the fluid then distends only the anterior urethra, where it should be held for a minute or so before allowing it to escape.

In the selection of an injection two questions must be weighed—namely, is the injection to be directed against the specific cause of the urethritis? or is it to be directed against the effect produced by the gonococcus, the congestion and suppurative inflammation of the urethra? When the pathology of specific or infectious urethritis is taken into consideration, it does not seem probable that gonococci, which have been found in the early stage to proliferate chiefly in the papillary layer of the mucous membrane, will be affected to any marked degree by an occasional and superficial application of a mild antiseptic? Later in the disease, however, when the gonococci are found on the surface of the membrane, even mild antiseptics may have decided effect, if not in killing the micro-organisms, at least in modifying their field of

[1] *Op. cit.*, p. 123.

growth. This same reasoning justifies the use of astringent injections: at the time when they are to be employed it is the effect of the gonococci, and not the gonococci themselves, that is to be combated.

A list of the chemicals which have been tried in the treatment of urethritis by injection would embrace nearly every known antiseptic, and include also many acids, alkalies, and insoluble salts. Each new agent that has been recommended has had for a time its advocates, and then has gradually fallen into disuse, owing either to its inefficiency or to its irritating qualities. In the experience of the writer the following prescription, a mildly antiseptic and astringent combination, has been found generally useful as the first injection in the beginning of the stationary period:

℞. Hydrarg. chlor. corrosivi,	gr. $\frac{1}{8}$;
Zinci sulphocarbolat.,	ʒss;
Acid. boric.,	ʒij;
Acid. carbolic.,	f℥ $\frac{1}{4}$;
Boroglyceride (25 per cent.),	f℥ij;
Aquæ destillat.,	f℥iv.—M.

Sig. Use locally; dilute if painful.

This injection is administered in conjunction with internal remedies until the discharge begins to get scanty and rather thin; then an injection slightly more astringent in its action is given until the discharge ceases entirely, usually in about the sixth week after the onset of the symptoms. For this second injection the following will be found useful:

℞. Zinci acetat.,	
Acidi tannic.,	*āā.* ʒj;
Acidi boric.,	ʒiij;
Aquæ destillat.,	f℥vj.—M.

Sig. For local use.

The administration of remedies by prolonged irrigation is chiefly applicable to those patients who can be treated in a hospital or who can devote themselves to their own treatment. It is the method to which the term "abortive" may be properly applied. Where the patient is kept under observation the treatment may be begun in the very earliest stages of the disease. One of the best means of irrigating the urethra is with a soft-rubber catheter attached by a long flexible tube to a jar containing the fluid to be injected; this jar is raised four or five feet above the level of the penis, and thus by the force of gravity the fluid is forced into the urethra. Instead of a catheter, a blunt two-way nozzle, such as has been devised by Kiefer, may be used; but where the urethra is much swollen and the glans œdematous the fluid is apt to make a short circuit and not penetrate the urethra farther than a half-inch or so. The patient should always urinate just before the irrigation is begun, in order to wash the pus from the anterior urethra, and then before the catheter or the nozzle is inserted the glans and the meatus should be thoroughly washed off with the stream from the irrigating jar. The catheter may be anointed with a 25 per cent. boroglyceride, or the

catheter may with advantage be dispensed with and a short meatus nozzle used instead. At least a quart of the antiseptic should be allowed to circulate slowly through the urethra each time. The chief benefit of the operation lies in the fact that the urethra becomes thoroughly saturated with the chemical, which then has a chance to reach even into the follicles to which the gonococci have penetrated in the early stages of the disease. Potassium permanganate, owing to its decided germicidal and astringent properties, is one of the most useful drugs for the purpose of irrigation. It should be used in a solution of 1 : 4000 strength for the first week, and may be then increased to the strength of 1 : 2000. Christian comes to the following conclusions [1] after making trial of four different forms of irrigation in a series of seventy cases of urethritis, both infectious and non-infectious, treated at the dispensary of the University of Pennsylvania : 1. That irrigation is a distinct advance in the treatment of gonorrhœa ; it relieves ardor urinæ and chordee more promptly than any other form of treatment, and is attended with a much smaller proportion of complications, such as total urethritis and epididymitis. 2. That permanganate of potassium is the best remedy for the purpose of urethral irrigation. 3. That irrigation of the urethra cannot be solely relied upon to completely cure specific urethritis. For the cure of the thin muco-purulent discharge which appears at the meatus in the morning some astringent injection administered by the patient himself is necessary: 4. That simple non-infectious urethritis can be cured within ten or twelve days by daily irrigations with potassium permanganate.

The substances which were used in these investigations were—potassium permanganate, 1 : 4000 for the first week, 1 : 2000 for the second week ; at the end of two weeks gonococci were found in only 5 out of the 16 infectious cases so treated. Nitrate of silver, 1 : 6000 for the first week, 1 : 3000 for the second ; at the end of two weeks gonococci were found in 16 out of 18 infectious cases. Bichloride of mercury, 1 : 15000 for the first week, 1 : 8000 for the second ; at the end of two weeks gonococci were found in all the 19 cases. Trikresol, .05 per cent. solution (a coal-tar product) ; gonococci were found in every case after two weeks' treatment.

In almost all cases, except where trikresol was used, the ardor urinæ and chordee were rapidly ameliorated, and the discharge showed a decided diminution even after two irrigations were given. It is, however, not unusual to find, after two weeks' treatment with irrigations, that the disease seems to come to a stand, and the discharge, although thin and scanty, still persists ; then the irrigations must be stopped and a mildly astringent but non-irritating injection given, such as sulphate of copper (gr. j–fl℥iij of water) or bismuth subnitrate (gr. x or xx to fl℥j of water).

When the urine no longer contains clap-shreds (small fragments of pus and mucus which are somewhat comma-shaped, and which sink rapidly to the bottom of the glass), and the patient has been free from discharge for at least ten days, then, and only then, can he be pronounced cured, and free to return gradually to his former habits of life. As long as there are any gonococci contained in the shreds in the urine there will be danger of infection from coitus.

[1] *Therapeutic Gaz.*, Nov. 15, 1894.

Acute Posterior Urethritis.—All injections in the anterior urethra must be stopped at the very first evidence of the development of posterior urethritis, of which the first symptom is usually diminution of the discharge and an increase in the urgency and frequency of urination. The constant and imperative calls to urination are the most annoying features of this complication, and their alleviation demands the first attention. One of the best means of reducing the vesical tenesmus is by means of hot rectal douches night and morning, or oftener during the day if possible; if there is much hæmaturia following urination, ice-cold rectal douches and cold compresses applied to the perineum will often prove effectual in stopping it; should these fail, ergot may be administered internally or given in the form of ergotin in the following prescription, recommended by Finger.[1]

℞. Ergotini, gr. xv;
Opii, gr. iss;
Sacch. alb., gr. xxx.—M.
Div. in pulv. v.
Sig. One powder every three hours.

In addition to the hot rectal douches nothing will be found as effectual as narcotics combined with belladonna administered in the form of suppositories night and morning after the douche. Potassium bromide and boric acid, each in ten-grain doses, should be given every three or four hours through the day. When the severity of the symptoms has diminished, then the deep urethra should be irrigated once daily with a warm solution of potassium permanganate of 1:4000 strength.

After two or three days of this treatment, provided no further complications, such as prostatitis or epididymitis, ensue, the irrigations may be replaced by deep injections of five to ten drops of a 1 per cent. solution of nitrate of silver and the internal administration of capsules of sandal-wood and copaiba. The course of treatment thus detailed is that which is adopted in the dispensary of the hospital of the University of Pennsylvania.

Complications.—It is the exception rather than the rule when a case of infectious urethritis pursues the typical and uncomplicated course just described: complications, some due to carelessness, others to unavoidable extension and aggravation of the original disease, are almost sure to arise in every case. Whether or not these complications prolong the course of the disease depends largely upon the period during which they arise; for instance, those of the inflammatory period consist mainly of affections of the glans penis and the prepuce, and have no effect upon the urethral discharge, while those of the remaining two periods are much more serious and affect either the urethral mucous membrane or the neighboring structures to such an extent that the treatment of the main disease must be modified or stopped altogether until they subside.

The complications which may arise during the inflammatory period are balanitis, balano-posthitis, phimosis, and paraphimosis.

Balanitis is an extension of the inflammation from the urethra to the integument of the glans penis; it is frequently the result of irrita-

[1] *Op. cit.*, p. 134.

tion from the pus which is retained under the foreskin by the plug of absorbent cotton injudiciously but almost universally applied to protect the clothing. The glans becomes intensely red and raw in appearance, and is covered with a thin layer of sticky, foul-smelling pus; here and there on its surface are patches where the epithelium is eroded or where several herpetic vesicles have coalesced and ulcerated. The ulcers thus produced often closely resemble chancroid. According to Finger (p. 211), "they differ from the soft chancre only by their spontaneous development upon the basis of a balanitis." He further states that they furnish a pregnant illustration of his opinion that soft chancre is not a virulent affection, but is the product of the inoculation of pus or the different pus-producers. Balanitis is not an infectious disease, and is not caused by the direct action of any specific micro-organism, at least as far as our present knowledge and experimentation extend. It is often associated with infectious urethritis, but is not, however, an infection with gonococci.

When the prepuce can be retracted and the glans exposed, there is usually no difficulty in making a diagnosis if balanitis is present; the excoriated, purulent appearance of the glans is unmistakable. When the prepuce cannot be retracted, it is difficult to determine at the first glance whether the profuse discharge comes from beneath the prepuce or from the urethra. Under these circumstances the discharge must be washed away, and then the urethra compressed from behind forward that any pus therein contained may be squeezed out; otherwise the diagnosis must be made by a microscopical examination of the pus. If gonococci be found, there is also a specific urethritis, but if there be no gonococci there may be either a simple balanitis or else a non-infectious urethritis. It has been our experience at the dispensary of the University Hospital to find in every case of balanitis or balano-posthitis a bacillus with rounded ends and somewhat constricted in the middle like a dumb-bell; it occurs either singly or in chains of two or three, sometimes on the surface of epithelial cells, but more often lying free between the cells. Pure colonies were obtained on gelatin agar, but inoculation experiments have not yet been attempted. From its shape we were at first led to suppose that it was the bacillus described by Kretling[1] as the specific micro-organism of chancroid, but from the facility with which it was cultivated on gelatin agar that idea has been abandoned.

Balano-posthitis is merely a further extension of the inflammation to the inner surface of the prepuce; it is almost invariably associated with balanitis, and, as it is due to the same causes and follows the same course, it needs no further mention.

Treatment.—Protecting the glans and the prepuce from contact with the irritating discharge from the urethra, and keeping the inflamed surface dry by means of a simple dusting powder, are usually all that is necessary in the treatment of balanitis and balano-posthitis. Damming up the urethral discharge by means of plugs of unabsorbent cotton or by bandages, as before mentioned, is one of the most fruitful causes of this affection; it is therefore of primary importance to allow the free escape of the pus, and for this purpose the patient must be directed to

[1] *Archiv f. Dermatol. u. Syph.*, Wien, Heft 11.

employ antiseptic (borated or carbolated) absorbent cotton or to let the penis hang free in some sort of a bag (the toe of an old stocking is now the classical resource) which is supported with tapes tied, not around the penis, but around the waist; the discharge will then drip out and have no chance to accumulate under the foreskin. When the prepuce cannot be retracted sufficiently for the application of the dusting powder, then a subpreputial wash must be ordered, composed either of boric-acid solution or of potassium permanganate of 1:4000 strength. A mixture which is often more effective consists of carbolic acid, f℥ss; ext. opii aq., gr. xviij; liq. plumbi subacet. dil., f℥vj.

Phimosis occurring during the inflammatory period of infectious urethritis is due to the lymphangitis and cellulitis of the prepuce; it may be either partial or complete. When it is complete it must be overcome at all hazards before any proper treatment of the urethritis can be begun; when it is only partial (that is, when the prepuce can be retracted far enough to expose the meatus urinarius) and when there is no balanitis, the condition is of slight importance, and will usually subside with the subsidence of the acute symptoms.

Treatment.—In the majority of cases inflammatory phimosis will subside under the application of sedative and cooling lotions, of which the common lotion of lead-water and laudanum is one of the best; but if these fail, circumcision or incision of the prepuce will be necessary.

Paraphimosis complicating urethritis is due to the slipping back of the prepuce, rendered tense and inelastic by inflammation, until it constricts the penis behind the corona glandis and shuts off the return of the blood. Œdema soon sets in, and the more the glans and prepuce swell the tighter becomes the constriction, and, finally, if the condition is not relieved, ulceration and sloughing of the parts ensue. The œdema of the glans and prepuce gives the organ the appearance of lobulation with here and there deep furrows and grooves. The ring of constriction is usually situated in the furrow behind that caused by the glandular sulcus, and just where the skin and mucous membrane join. This is, therefore, the second one behind the corona. The condition is attended with considerable pain, which persists until the constriction is relieved by incision or by ulceration.

Treatment.—When paraphimosis is due simply to œdema and inflammation has not yet set in, it should be reduced at once; otherwise the plastic inflammation which soon supervenes will render the reduction difficult. In reducing a paraphimosis the glans should be compressed with the fingers of one hand while the sheath of the penis is pulled forward with the other hand until the glans slips under the constriction. The operation will be greatly facilitated if the glans and prepuce be thoroughly oiled. When this means of reduction fails the penis should be wrapped with lint, and then a piece of elastic ligature should be wound around the glans from before backward until the corona glandis is reached, when it will be possible to slip a grooved director beneath the constriction, and, letting loose the elastic binding, the foreskin can be then quite readily pulled forward into its proper position. When the œdema is marked the serum must be made to escape by means of numerous punctures.

If the paraphimosis be not reduced at the start, then very soon the

effusion of plastic lymph speedily makes it much more serious, and prolonged compression by means of strips of adhesive plaster must be resorted to; under this treatment, usually at the end of twenty-four hours, the swelling will be reduced sufficiently to allow the foreskin to be slipped forward. If at the end of this time reduction is still impossible, a sharp-pointed bistoury should be slipped beneath the prepuce and an upward cut through the constriction should be made or the constriction may be divided from above downward.

Folliculitis and Periurethral Abscess.—In the early part of the stationary period of infectious urethritis usually there can be felt along the course of the urethra, on the under surface of the penis, numerous small lumps about the size of a split pea; they are slightly painful on pressure, and as the finger is passed over them they feel very much like a string of beads. These small lumps are the dilated and inflamed follicles, the *glands of Littre*, along the floor of the urethra; they occasionally enlarge to a considerable extent, and may open and discharge externally, seldom, however, giving rise to a urethral fistula. The follicles which are most frequently observed discharging externally are those situated close to the meatus, and which open in the coronary sulcus on either side of the frænum. The pus exuding from these small openings will, in the majority of cases, be found to contain gonococci. In a patient recently treated at the hospital of the University of Pennsylvania, a glandular hypospadias permitted the largest of these urethral mucous follicles, that situated on the upper surface of the fossa navicularis, the *lacuna magna*, to be clearly seen. Long after the discharge had ceased to issue from the urethra it still persisted from this little pouch, and ceased only after the orifice was slit open and a 10 per cent. solution of nitrate of silver freely applied. It is very probable that many of those cases, where there is no evidence of stricture nor posterior urethritis, and where a slight discharge persists after all the acute symptoms have disappeared, are due to just such a condition as this. I have frequently cured them by carrying silver-nitrate solutions to the bottom of the lacuna by means of fine swabs or by slitting up the lacuna with a sharp-pointed tenotome.

The small follicular abscesses generally open spontaneously into the urethra, and seldom cause serious symptoms; should they point externally, they should be drained by free incisions.

When the suppuration extends beyond the follicles, it then penetrates into the cavernous tissue, and the more serious condition of periurethral abscess ensues. Periurethral abscesses are most apt to form around the deeper parts of the urethra, chiefly in the bulb, owing to the greater number and greater depth of the follicles there. When they once start they usually develop quite rapidly, causing considerable pain and occasionally impeding the flow of the urine from their encroachment on the urethra. From the very nature of their formation they seldom open into the urethra; before the follicle begins to enlarge its communication with the urethra is shut off by inflammation; therefore the abscesses point in the direction of least resistance, which is usually outward in the perineum. Should they communicate with the urethra only, there is some danger of urinary infiltration. Furthermore, if they open internally, and at the same time the skin breaks down, an additional risk of urethral fistula is incurred.

Periurethral abscesses, if treated in their earliest stage by external applications of sedative lotions, free purgation, and absolute rest in bed, may frequently be aborted; otherwise, as soon as suppuration is established they must be evacuated by an incision through the skin; the risk of fistula is subordinate to that of urinary infiltration.

Cowperitis.—Cowper's glands are two compound racemose glands about the size of a pea; they are situated just back of the bulb, and their ducts run forward through the corpus spongiosum for about an inch and then open on the floor of the bulbous urethra.

When the urethritis has extended as far as the bulb—that is to say, at the end of the first or middle of the second week of the affection—the inflammation may extend to one or both of the glands of Cowper. This condition is made known by a decided diminution of the discharge, possibly a complete cessation; the patient complains of a sharp pain in the perineum a little behind the scroto-perineal junction, and in this locality the swollen gland or glands may be felt. They are painful on pressure, and appear to be about three-eighths or half an inch in diameter. If the patient is at all inclined to constipation, defecation becomes very painful. The inflammation may subside after giving rise to no further symptoms than those just mentioned, or more rarely it may go on to suppuration and provoke a sharp throbbing pain in the perineum, and all the constitutional symptoms of suppuration. The abscess may finally open, either internally or externally; in the former event, as in the case of periurethral abscess, the danger of urinary infiltration is great.

The **treatment** consists of immediate cessation of all urethral injections and the application of cold compresses and sedative lotions to the perineum; if suppuration has begun, the abscess must be opened in the perineum at once.

Lymphangitis and Inguinal Adenitis, or Bubo.—In a certain proportion of virulent cases the lymphatics which run along the dorsum of the penis become inflamed and indurated from absorption of the pyogenic microbes—not so much, however, from the suppuration going on in the urethra as from a condition of balanitis due to carelessness in the removal of the discharge. These inflamed lymphatics are usually slightly raised and the skin above them tinged with red. The lymphangitis is not of itself painful, but may add to the discomfort when the penis becomes erect. Sedative lotions, such as lead-water and laudanum, are generally all that are required to allay the pain and dispel the inflammation.

Inguinal adenitis, or *bubo*, may arise independently or it may be a direct extension of the lymphangitis. The process begins with a slight swelling of one of the superficial glands just below Poupart's ligament; at first the gland is freely movable and only slightly painful on pressure; soon, however, it enlarges considerably and becomes adherent to the overlying skin, which then assumes a tense and inflamed appearance. At this stage the bubo often can be aborted by the application of tincture of iodine and compression with a tight bandage. When the general condition of the patient is feeble, or if there be a tuberculous tendency, instead of undergoing resolution the gland may suppurate, in which case a warm antiseptic fomentation should be applied for twenty-four hours, and when pointing is well established the abscess should be freely opened

and all portions of the gland not thoroughly disintegrated must be removed with a curette, and the cavity packed with iodoform gauze. When apparently only one gland is implicated and has been entirely destroyed by suppuration, then a simple puncture, followed by thorough irrigation of the cavity and the insertion of a narrow strip of gauze to keep the opening from closing too soon, will often prove effectual and be much more agreeable to the patient. If there is a periadenitis and the glands have not been thoroughly destroyed, this method is not justifiable.

Prostatitis.—In the subsiding stage of infectious urethritis, when posterior urethritis is most likely to develop, the prostate gland may become involved, and give rise to the painful and somewhat serious condition of prostatitis. A general congestion of the gland is the first manifestation of the disease, and causes a feeling of weight and distention in the perineum, and considerable vesical tenesmus; frequently the patient is compelled to pass his urine every half hour or fifteen minutes; defecation becomes painful, and a slight hæmaturia at the close of urination is not an uncommon symptom; in a similar manner the pollutions, which are apt to be caused by the hypersensitive condition of the gland, will frequently be tinged with blood. When felt through the rectum the gland seems considerably enlarged and is hot and very tender, and somewhat more firm in consistence than normal. The congestion may subside without giving rise to any further symptoms, or the follicles may become infected, and then, instead of having the smooth, rounded surface as in simple congestion when felt through the rectum, the gland will appear to be studded here and there with small nodules. Instead of increasing, the discharge diminishes, but, owing to the backward flow of the pus into the bladder when the urine is passed in two portions, both portions will be clouded. Pain on micturition and defecation is very severe, and vesical and rectal tenesmus are marked symptoms for a day or so; the follicles rarely suppurate, however, and resolution and absorption are the rule. If suppuration does take place, the abscesses open into the urethra.

When the parenchyma of the gland becomes affected, the symptoms are the same as in the two preceding forms, but they are all more accentuated, and in addition there is often associated a considerable degree of fever. The swelling of the gland may become of sufficient size to cause almost complete retention of urine, and even render defecation not only extremely painful, but also very difficult. At the end of three or four days fluctuation becomes evident, and if the abscess be not opened by the surgeon it will rupture into the urethra, the rectum, or externally in the perineum, or more rarely into the ischio-rectal space.

The prognosis is affected somewhat by the possibility of urinary infiltration should the abscess open into the urethra, or the likelihood of extensive sepsis should it open into the rectum. I have, however, never seen either of these accidents prove fatal. If the abscess unequivocally points toward the perineum, early opening is the proper treatment.

When there is evidence of simple or follicular prostatitis, all treatment of the anterior urethritis in the form of injections must be stopped at once, and the patient kept absolutely at rest in bed, with the pelvis slightly raised on a hard pillow. The diet should be restricted, as far as possible, to skimmed milk, which may be taken in any quantity. The

bowels must be kept freely opened, and sexual excitement of any description must be inflexibly avoided. For the purpose of applying cold through the rectum Finger has devised a rectal psychrophore which can be placed directly against the prostate in the rectum, and then a stream of ice-cold water made to circulate through it; the inventor claims[1] that the application of cold by this means for an hour two or three times each day suffices to dispel the inflammation, even in acute and considerable swellings. The symptoms will be much alleviated also by the application of heat in the form of hot rectal douches or enemata of starch-water containing a few drops of laudanum. At night the pain and frequency of urination may be controlled by means of opium combined with belladonna or hyoscyamus in suppositories.

Epididymitis.—Like prostatitis, epididymitis only arises when the inflammation has extended back to the posterior urethra; according to the statistics compiled by Finger,[2] which include 1015 observations, more than 50 per cent. of the cases of epididymitis begin in two to five weeks after infection; 191 cases out of this number occurred in the fourth week alone. In another table, gathered from a different source by the same author, the very slight preponderance of right-sided over left-sided epididymitis is noticeable; out of 3136 cases, the right side alone was affected in 1500, the left side in 1425, and both sides in all of the remaining 211 cases.

The condition is popularly known as "swelled testicle," owing to the fact that the enlarged epididymis so masks the testicle (which is also obscured by the accompanying acute hydrocele) that the dividing-line between these two structures can be made out only by an experienced hand.

The condition is, without doubt, due to the direct extension of the specific inflammation through the ejaculatory ducts and spermatic canal to the epididymis, but as far as can be ascertained there has been no absolute proof of the presence of gonococci in the epididymis itself or in the spermatic canal. Probably the most complete idea of the pathological anatomy of this affection is given by the investigations of Malassez and Terrillon:[3] "In beginning epididymitis they found the epithelium of the seminal canals in a condition of cloudy swelling and destitute of cilia, the remaining tissues normal. A higher grade is characterized by œdema of the walls with small-cell infiltration. In still more advanced stages the loose tissue around the seminal canals is infiltrated and swollen; the canals themselves are filled with a yellowish-green fluid, consisting of semen and pus. The nodules of the advanced stages are formed of densely-infiltrated connective tissue surrounding the seminal canals."

The onset of epididymitis is rapid; only very occasionally does the patient feel any prodromal symptoms which lead him to suspect that the inflammation is about to attack the cord and epididymis. The aching which is usually felt in the groin along the line of the cord is in general attributed to an inflammation of the inguinal glands, when in reality it may be the beginning of the inflammation which rapidly spreads down to the epididymis. As soon as the epididymis becomes involved there is a dragging heaviness and also a peculiar nauseating pain felt in the tes-

[1] *Op. cit.*, p. 234. [2] *Op. cit.* [3] Quoted by Finger, p. 251.

ticle of the affected side. The epididymis enlarges rapidly, and the scrotum soon becomes enormously distended and red or dark purple in color. The patient whose testicle is thus affected and is not supported will assume an almost characteristic gait—somewhat stooping, the legs far apart; the leg on the affected side swings round at the side instead of being advanced.

Epididymitis, as a general rule, reaches its acme about the end of the third day, remains stationary for about two days, and then gradually undergoes resolution; but the induration of the nodules in the tail or the head of the epididymis never entirely disappears. When the disease is bilateral, especially if the tails of the epididymes remain indurated, a condition of aspermatism results; whether or not this condition is permanent is somewhat doubtful. Suppuration is rare; when it does occur and the abscesses open externally, hernia testis is almost sure to result.

Treatment.—The patient developing epididymitis should be put to bed at once, and the scrotum should be elevated on a pad of cotton; free movements of the bowels must be maintained and the diet restricted to the very lightest food. If there be any fever, it is well to give a drop of the tincture of aconite and five grains of bromide of potassium every two or three hours. The affected testicle should be wrapped in lint and kept constantly moistened either with lead-water and laudanum or the following lotion:

℞. Tinct. aconit.,
Tinct. opii, āā. f℥j;
Liq. plumbi subacetat. dil.,
Aquæ, āā. f℥ij.—M.

Cold (but not iced) compresses will often prove very comforting in many cases. Rest is, however, the chief factor in the cure; the disease almost invariably terminates favorably.

When the patient cannot keep in his bed, the next best thing is the support given by a suspensory bandage, which can be laced up at the sides so that an even, firm pressure is exerted on all sides, and the testicles are perfectly protected and kept closely against the body. The whole scrotum may be wrapped with lint soaked in lead-water and laudanum, and it is well to put outside of this a sheet of thin rubber cloth or oiled paper to keep in the moisture; the suspensory bandage should envelop this and be laced up the side as tight as the patient can bear. The relief experienced immediately after the application of such a bandage is often remarkable; the patient, who before was scarcely able to walk, in many cases will be able to resume his occupation at once. The bandage should be worn throughout the day, but loosened at night. Another method, which has the same object in view, is strapping the testicle with strips of adhesive plaster: the testicle is first drawn down in the scrotum, and then a strip of adhesive plaster is drawn up in the median line of the scrotum, thus dividing the unaffected from the affected testicle, and encircling the cord above the globus major of the epididymis close to the body; narrow strips of adhesive plaster are then applied from above downward around the bottom of the scrotum, each one

overlapping slightly the one above it. By this means also the testicle is well protected and firmly compressed; but when the swelling is only moderate it is quite difficult to apply this dressing tightly, and unless it is tight the dressing is worse than useless. There is really no better method of treating an epididymitis, whether the patient remains in bed or not, than by the application of a well-fitting suspensory bandage.

Cystitis.—True cystitis is a very rare complication of infectious urethritis; what is frequently called—or rather miscalled—cystitis is probably in reality nothing more than a severe form of posterior urethritis and a certain degree of prostatitis.

The **symptoms** of cystitis developing in the course of an infectious urethritis are the same as when the cystitis arises from any other cause; it is, however, usually preceded by posterior urethritis. The three-glass test will show cloudiness in all three portions of the urine, and in true gonococcus infection the shreds and pus contained in the last portion will contain the specific micro-organism. In addition to the vesical tenesmus, which is present also in posterior urethritis, there is usually, when cystitis develops, a much more marked degree of hæmaturi and pyuria.

The **treatment** of this variety of cystitis is the same as for any other variety, except that, since the condition does not depend on any grave organic changes, it does not require such energetic or radical measures to combat it. One of the most effectual means of treating the posterior urethritis and the cystitis at the same time is by injecting the bladder with a solution of potassium permanganate in the strength of 1:4000, and then letting the patient urinate it out as soon as the bladder becomes distended; by this means the mucous membrane of the bladder and the most posterior part of the urethra are thoroughly disinfected. As the patient gets used to the injection the strength of the solution may be increased up to 1:2000, or even a little stronger. If the urine is loaded with thick mucus and pus, it is advisable to wash out the bladder with warm distilled water before the potassium permanganate is injected, in order that the solution may come in close contact with the mucous membrane. Constitutional symptoms as they arise should be treated on the general principles detailed in the section on Cystitis.

Valentine[1] details as follows the method which he ascribes to Janet of Paris: The apparatus employed consists essentially of a glass irrigator capable of holding 2000 grammes; to this is attached a rubber tube 300 centimetres (about 120 inches) long, whose free end is slipped over a glass nozzle about 7 centimetres long and 6 centimetres in circumference, running to a blunt point, which can easily be pressed into the meatus to occlude it entirely. Frank of Berlin uses a nozzle with an entirely flat point for very sensitive cases with exceedingly small meati.

The irrigator is filled with a warm solution of permanganate of potassium. The irrigator is then drawn upward by a cord attached to it and passing over a pulley fixed at 2½ metres above the table or chair employed. The irrigator is raised to a height which allows a gentle stream to escape from the nozzle. The patient, after urinating, sits or lies down, and the prepuce, glans, corona, and meatus are carefully cleansed with the solution in the order in which they are mentioned. Then the penis is firmly

[1] *Journ. of Cut. and Gen.-urin. Dis.*, June, 1895.

e of the solution allowed to flow into the meatus and pe at once. This is repeated, meanwhile gradually raising or still farther, until successive washings have rendered the as clean as possible. Then the nozzle is held in the meatus, e the patient breathes deeply or makes efforts at urination, until to 500 grammes of the solution have flown into the bladder. In t cases the constriction will be quite readily overcome by the pres-; in others some patience is required. When the bladder is filled patient is allowed to extrude the fluid, which flows in a vigorous m.

solution first used is of a strength of 1 part potassium permanate to 6000 of warm water; as tolerance is established this proporincreased to 1 to 4000, later to 1 to 2000, and finally to 1 to 1000. se vesical injections are made twice, thrice, or four times on the day; twice on the second, third, fourth, and, if required, on the day, when usually all gonococci have disappeared; then once a day all discharge has ceased, which in Janet's severe cases occurred on tenth day. Valentine says that his success has not been so favor-; he has had several cases in which the flow persisted until the fifth day.

ore each injection a slide is made for microscopic examination. e first and second days but little change appears. Thenceforward gonococci grow sparser in number, and generally on the fourth day, they have a swollen appearance; the lumen between each pair occi seems wider, and nowhere can any tendency to further ation be observed. They probably are then undergoing a species volution, or may be returning to that state in which some authors them as normal residents of the urethra. On the following day e pus, which has become thin and water-colored, is found free of gonococci. Then the injections need be given but once a day until the flow ceases entirely. This frequently is on the sixth day of treatment.

The patients are told to return one week after the flow has ceased. An irritant injection of silver nitrate is then made. A strength of 2 per cent. generally suffices to produce a copious flow within six to twelve hours. If this flow is found to contain gonococci, the procedures above described are repeated until the discharge ceases. The patient is then allowed to rest from treatment for another week. The discharge then produced by silver nitrate contains no gonococci, and disappears within twenty-four to forty-eight hours, as do other simple urethrites, without any treatment whatever. If, however, the discharge evoked by the first silver-nitrate injection shows no gonococci, which occurs, it is claimed, in the vast majority of cases, the patient receives another such injection a week later, and, if then the discharge is free from gonococci, the patient is discharged, cured.

Inflammation of the Seminal Vesicles.—Acute vesiculitis is an occasional complication of acute posterior urethritis. The inflammation having made its way into the common ejaculatory ducts opening on the floor of the prostatic urethra, invades the vesicles themselves. Jordan Lloyd (quoted by Jacobson) believes that as a complication of gonorrhœa it is as common as epididymitis, possibly even more common, and that an infectious inflammation which has once reached the orifice of the

ejaculatory duct "is much more likely to extend along the half inch direct into the vesicles than along the sixteen-inch passage to the epididymis."

The **symptoms** produced by vesiculitis are much the same as when the prostate is actually inflamed; the enlarged vesicles can be felt through the rectum running up along the under surface of the bladder behind the prostate; they are somewhat nodular and feel abnormally tense and hot. They can be more readily felt when the bladder is full. Even slight pressure causes considerable pain. Frequent and imperative urination is always a prominent symptom; the urinary reflex is almost constantly excited, owing to the irritation being marked in the neighborhood of the verumontanum, whence the urinary impulse starts. The congestion of the seminal vesicles and the prostatic urethra also gives rise to frequent nocturnal and occasional diurnal pollutions, usually painful. Priapism may be a marked symptom. When the urine is passed in two portions, the second portion will contain, in addition to the pus and "clap-shreds," numerous dead spermatozoa; the latter may also be found in the discharge from the urethra when this persists, as it sometimes though rarely does, after the development of vesiculitis.

The inflammation usually subsides rapidly under appropriate treatment, but it may become chronic, and give rise to a most obscure and diverse series of symptoms, prominent among which are mental depression and abnormally frequent pollutions, with general loss of sexual power.

When the acute symptoms subside and the tenderness disappears, and the urine has regained its normal clearness, if the patient is made to urinate in two portions after the prostate and the seminal vesicles have been massaged per rectum, the first portion of urine will contain thick, ropy, white masses composed of the seminal fluid, and often containing spermatozoa, either living or dead.

Vesiculitis may be a very serious affair if it results in abscess with perforation into the bladder within the limits of the peritoneal covering, or directly into the peritoneal cavity by way of the recto-vesical cul-de-sac. Cases of both these accidents have been reported. Pyæmia has also been known to follow a septic phlebitis of the adjacent venous plexuses; pelvic cellulitis with diffuse suppuration has resulted; and various troublesome abscesses burrowing between the bladder and rectum, and leaving fistulous tracts very slow to heal, have had their origin in suppurative vesiculitis. The chronic form may be associated with persistent vesical irritability, with some pain on emission of semen, with sexual excitability accompanied by premature ejaculation, and with persistent urethral discharge often mistaken for an ordinary gleet. I have known internal urethrotomy to be performed under these circumstances, the imaginary stricture probably having been the edge of the subpubic ligament. Fuller[1] strongly advocates "stripping" (*i. e.* stroking from behind forward) the vesicles by means of a fore finger in the rectum in cases of chronic vesiculitis, and gives instances of benefit which has resulted in cases previously rebellious to treatment.

Treatment.—Acute vesiculitis usually yields rapidly to rest and general hygienic precautions, such as regulation of the bowels and mod-

[1] *Journ. of Cut. and Gen.-urin. Dis.*, Sept., 1893, and June and July, 1894.

ification of the urinary secretion so that it shall not be irritating to the mucous membrane of the urethra. The tendency to nocturnal pollutions should be governed, as in prostatitis, by means of the bromides, and also by opium and hyoscyamus in the form of suppositories. Cold rectal douches, and especially the rectal psychrophore, as advised by Finger in the treatment of prostatitis, will generally give most satisfactory results in the way of diminishing the pain and inflammation. When the disease becomes chronic it is most difficult to cure, and the despondency into which the patient falls inclines him to regard his case as hopeless, and makes him constantly change his physician, and renders prolonged methodical treatment impossible. In this case also cold rectal douches and the psychrophore applied high up in the rectum yield good results, and when the symptoms begin to be less intense the application of nitrate of silver in 2 per cent. solution to the prostatic urethra relieves the vesical tenesmus and the irritability of the verumontanum.

NON-INFECTIOUS URETHRITIS, a somewhat rare disease, in its course and symptoms closely resembles the infectious inflammation; it is, however, never as severe, and is not usually followed by any immediate complications, such as epididymitis, prostatitis, etc. The cause of the disease is either traumatism inflicted by the use of septic instruments, or irritation from acrid vaginal discharges which do not contain the gonococcus.

One of the chief distinguishing characteristics of the disease, apart from the mildness of the symptoms, is that it is never preceded by a period of incubation between the time of exposure or injury and the development of the discharge. The symptoms rapidly reach their acme, and seldom consist of more than a redness and pouting of the lips of the meatus, a scanty muco-purulent discharge, and slight burning on urination, and possibly a slight undue frequency of urination.

Treatment.—Being a non-infectious disease, there is but little likelihood that it will be transmitted to the posterior urethra. Injections given in the earliest stage in this form of urethritis are therefore of great use if mildly antiseptic and sedative. Prolonged irrigation with potassium permanganate in 1 : 4000 solution, and the internal administration of the balsams of sandal-wood and copaiba, are also useful, and will usually dispel all symptoms in two or three days. The gravity of the non-infectious urethritis which arises from traumatism of course depends upon the extent of the injury to the mucous membrane and the subjacent tissues, whereof the cicatricial contraction may result in the formation of stricture.

CHRONIC URETHRITIS.—If acute urethritis be improperly treated in the beginning, or if neglected or if frequent relapses or renewed infections occur before the discharge has ceased, it becomes chronic and more or less localized in certain portions either of the anterior or posterior urethra. The symptoms are never very severe, and the discharge is visible either as mere shreds in the urine or as a morning drop; ardor urinæ still persists to a slight degree (usually not more than a feeling of undue warmth and friction in the passage of the urine), and, especially if the inflammatory process involves the posterior urethra, urination is frequent and imperative.

CHRONIC ANTERIOR URETHRITIS.—When the inflammation becomes

chronic and localized in patches in the anterior urethra (that is to say, in the pendulous portion and as far back as the bulb), which, according to the investigations of Weichselbaum's institute,[1] is the most frequent seat of chronic urethritis, a slight discharge, mucoid and rather thin in character when the disease is of long duration, is almost constantly noticeable at the meatus. When the discharge is not profuse enough to flow freely, but just enough to cause a constant gluing of the lips of the meatus, this condition gives rise to a forking and twisting of the stream at the commencement of each act of urination; these deviations of the stream are considered by many to be almost pathognomonic of urethral stricture: that it is either incipient or already formed when this symptom is present is in very many instances undoubtedly true, but when the twisting or forking occurs only when the first urine passes, it is probably due not to stricture, but only to the pus at the meatus; when there is deviation or forking not only at the beginning of urination, but also throughout the act, it may originate in a glued meatus, but its continuance is more likely to be due to stricture. The discharge is always most profuse in the morning, when the urethra has been at rest for a long time and the pus has had a chance to accumulate; if the urethra be squeezed before the first urine is passed, a large-sized drop can be usually pressed out; this morning drop is notoriously characteristic of chronic anterior urethritis. The first three or four ounces of the urine contain the pus and epithelial cells which have desquamated in the anterior urethra and as the stream of urine passes through the canal; the pus, epithelial cells, and mucus are rolled up into long shreds, which, if the pus predominates, rapidly sink to the bottom of the glass. There is likely to be some undue frequency of urination, but the patient can usually restrain the impulse for a considerable time, except when the posterior urethra is also involved. Congestion makes the mucous membrane extremely sensitive to the slightest irritation; consequently any excess, either sexual or alcoholic, produces an increased flow of blood to the sexual organs or else makes the urine more irritating, and the discharge at once becomes more profuse. When these excesses, followed by the inevitable increase of the discharge, are intermittent and frequent, the semblance is given, even after a healthy coitus, of as frequent reinfections.

After the acute process subsides the inflammation becomes limited chiefly to the minute mucous glands which are distributed over the mucous membrane in the spongy portion of the urethra; around the orifices of these glands the mucous membrane remains inflamed and swollen, and sometimes slightly eroded, and bleeds from comparatively slight irritation. As seen through the endoscope the entire mucous membrane is deep red, with these small spots of deeper color scattered thickly over it. Occasionally the ducts of these glands of Littre (as the aforementioned mucous follicles are called) become occluded, and the glands are converted into small cysts, which then appear like minute white dots scattered over the deeply-congested mucous membrane.

When the inflammation and swelling extend beyond the walls of the follicle into the submucous tissue, and even into the tissue of the corpus spongiosum, the neighborhood of the gland becomes somewhat exsan-

[1] Quoted by Finger, p. 139.

guined from the pressure and from the fibrous exudate: this is the beginning stage of stricture, and from this time on the mucous and submucous layers become more and more infiltrated in circumscribed areas until a contraction takes place around the whole circumference of the urethra. When the anterior urethra is examined with bulbous bougies, several points of marked tenderness will be found which bleed easily: these are patches of erosion where granulations have arisen. When they are quite superficial (that is, do not extend beneath the mucous membrane) they do not cause contraction when they cicatrize.

CHRONIC POSTERIOR URETHRITIS seldom if ever gives rise to any discharge visible at the meatus, unless there is also an inflammation of the neighboring glands, the prostate, and the seminal vesicles, or of their ducts, which open into the urethra in the prostatic portion. One of the most common signs of chronic posterior urethritis is the cloudiness of the second portion of urine when the two-glass test is applied; Finger points out that this test does not always give the precise knowledge of the situation of the inflammation that is claimed for it. When the discharge is scanty and very tenacious, it will not flow backward into the bladder and mingle with all the urine therein contained, but will be washed out with the first urine. Shreds will only appear in the second portion of urine, he maintains, under the following conditions: When not enough urine is passed in the first portion to wash out the urethra thoroughly; when the urine has been retained so long that the prostatic urethra undergoes a physiological dilatation and becomes part of the bladder and the entire urine becomes clouded; and lastly, when the shreds do not come from the mucous membrane, but are pressed out of the prostatic glands or their excretory ducts during the evacuation of the last few drops of urine.[1]

From this it will be seen that the two-glass test yields inadequate information in many cases. If the urine is clear except for the presence of "clap-shreds" in both glasses, it shows that there is chronic urethritis, but it is impossible to say whether it is limited to the anterior or to the posterior urethra; similarly, when the shreds are found only in the first portion, they may have been washed out from the posterior urethra. When at the first examination the shreds are noticed chiefly in the first portion, it will be necessary at the second application of the test, in order to determine whether they come from the anterior urethra alone, to pass a catheter down to the bulb and to wash out the urethra thoroughly from that point; if after this shreds are still found in the urine, then they must come from the posterior urethra. Besides this method of determining the locality of the inflammation, the shape of the shreds is often an indication of their origin: those shreds which are formed in the anterior urethra are always in long twisted threads or rolls of epithelial cells, pus, and mucus, just as they are gathered up by the stream of urine, while the "clap-shreds" from the posterior urethra are the particles of the secretion which are contained in the ducts of the prostatic glands, and which are pressed out by the contraction of the muscles: they are somewhat shorter and thicker than the anterior shreds, and usually, as has been mentioned before, sink rapidly to the bottom of the glass.

[1] *Op. cit.*, p. 183.

The **symptoms** of posterior urethritis are chiefly frequent and imperative urination, and most probably, if the prostate is also involved, a sticky whitish discharge of prostatic fluid which issues from the meatus whenever there is straining at stool. In the majority of cases this discharge which appears during defecation is purely prostatic; occasionally there is also a true spermatorrhœa, and either living or dead spermatozoa will be found in considerable numbers in the urine, either free or entangled in the clap-shreds. A certain amount of pure prostatic discharge will appear at the meatus after defecation in robust and entirely healthy young men, especially if they are continent. In chronic urethritis the inflammatory rigidity of the openings of the ejaculatory ducts prevents their perfect closure, and hence the escape of the contents of the seminal vesicles each time they are pressed upon. In addition to these leading symptoms, there is a host of minor symptoms limited only by the imagination of the patient: mental depression is always marked, and it may be said with almost perfect truth that the mental effect produced by a persistent urethral discharge is the inciting cause of a large proportion of all suicides.

The **treatment** of chronic urethritis is chiefly local; internal remedies can assist in the cure only by building up the general state of the health. When the pathological condition of the mucous membrane is taken into consideration, the necessity of overcoming any constriction of the calibre of the urethra, and also of opening out the follicles, will be at once apparent. In order to detect the slight differences in the calibre of the urethra which may be present at this stage, and which hardly deserve the name of stricture, an examination either with a bougie à boule or with a urethrameter must be made.

The largest-sized acorn-headed bougie which will slip through the meatus should be tried first, and as it is passed down into the urethra the position of the points of narrowing should be noted, as should also those points where there may be no narrowing, but where the patient feels sharp pains, which indicate granular patches; if the instrument be passed down as far as the prostatic portion of the urethra, when it is withdrawn the character of the secretion which it brings out on the shoulder of the bulb often serves to show whether or not the prostate is affected by the presence of the glutinous prostatic fluid; the presence of blood indicates that there are granular patches. The urethrameter, an adjustable and recording exploratory bougie, is thus described by F. N. Otis, who devised it:[1] "It consists of a small, straight cannula, size No. 8 F., terminating in a series of short metallic arms hinged upon the cannula and upon each other. At the distal extremity, where they unite, a fine rod, running through the cannula, is inserted. This rod (which is worked by a stationary screw at the handle of the instrument) when retracted expands the arms into a bulb-like shape 10 millimetres in circumference when closed, and capable of expansion up to 40 millimetres. A thin rubber stall drawn over the instrument when closed protects the urethra from injury, and prevents the access of the urethral secretions to the interior of the instrument." The advantages which are claimed for this instrument over the ordinary flexible exploratory bougie are that it can be introduced through a meatus which is much too small to

[1] *Stricture of the Male Urethra*, p. 77.

allow a suitable bougie to pass, and by introducing the instrument down to the deep urethra, and then opening out the bulbous end and withdrawing the instrument, slowly expanding and contracting it here and there to fit closely to the calibre of the urethra, and noting the variations on the scale of the handle, an accurate knowledge of the irregularities of the urethral calibre can be gained by a single insertion of the instrument, whereas numerous ordinary bougies would have to be inserted and withdrawn in order to gain the same amount of knowledge. The use of the urethrameter is undoubtedly a refinement in the diagnosis of incipient stricture, but for all practical purposes the bougie à boule will give a sufficiently accurate knowledge. If no strictures be present, but the passage of the instrument causes pain and slight hemorrhage at certain points, the diagnosis of granular urethritis may be additionally confirmed by inspection through an endoscope. (For a description of the first endoscopes for examination of the urethra and bladder, as devised by Desormeaux, see the section on Cystoscopy.)

Of all the forms of endoscope devised for diagnosis and treatment of urethral lesions, that devised by Klotz and modified by Otis is perhaps the most serviceable, inasmuch as it allows of easy access to the diseased spot, and the illumination is sufficiently bright to make apparent even very slight lesions. It consists of a straight silver tube with a wide flat flange at one end; the tube is used in conjunction with a hand-mirror, and when inserted in the urethra a rounded obturator is so fitted in that the sharp edge cannot lacerate the mucous membrane. Otis's modification is a small detachable electric lamp with reflector fastened to the wide plate or flange of the urethroscopic tube. The light is concentrated by a lens and reflected down the tube, and when an application is to be made to the mucous membrane the lamp can be removed and the applicators inserted into the tube.

Whenever it is apparent that there are incipient strictures, or where there are granular patches in any part of the urethra, or the follicles are clogged with pus, then the obvious indication is to restore the normal calibre of the urethra and to empty the follicles: for this purpose there is no means more efficient than the introduction of a full-sized steel sound. If the meatus is of smaller calibre than any of the "soft strictures," as these incipient narrowings have been termed, it must be enlarged to the normal calibre of the canal by cutting down upon the floor of the urethra and if necessary dividing the frænum down its centre. This operation, apparently so simple, requires no small degree of care and judgment; it should be performed under an anæsthetic, either local or general, and it is safer to make several small successive tentative cuts with the blunt-pointed tenotome until the meatus will exactly admit a sound of the desired calibre. If the meatus is too much enlarged, it is almost as troublesome as if it were too small; the exposed condition of the mucous membrane of the fossa navicularis occasions a state of chronic irritative urethritis.

After the passage of the sound a drop of pus is often noticeable at the meatus as a result of the stretching of the ducts of the follicles, albeit the urethra has been thoroughly washed out either by irrigation or by urination just before the instrument was introduced.

The sound should be passed every third or fourth day, and in the

interim, if the lesions are chiefly confined to the anterior urethra and are granular, a mildly astringent injection, such as zinc sulphate or tannic acid, frequently will be beneficial; if the posterior urethra is affected, deep instillations of nitrate of silver in 5 or 10 per cent. solution should be given by means of a prostatic syringe, or the deep urethra irrigated with silver nitrate, 1:6000 or 1:3000. Inveterate cases in general will yield only to stronger local applications, which can be best made directly to the affected spot through an endoscope.

Instead of deep urethral injections the remedies may be applied to the prostatic urethra in suppositories of cocoa butter introduced by means of Dittel's *porte remède*, which consists of a tube curved like an ordinary sound, into which the suppository is inserted, and then, after the tube has been introduced to the desired depth, the suppository is pushed through by means of a flexible obturator.

To overcome the almost inevitable mental depression and general constitutional weakness which accompany this condition general tonics, strychnia, phosphoric acid, and pure nitromuriatic acid, are often indicated. There is, nevertheless, in all these cases a grave possibility of over-treatment; wherefore the slightest improvement in the symptoms should always be met with a corresponding decrease in the treatment; either the sounds should be passed less often or the deep urethral injections or irrigations should be temporarily suspended.

Even under the best treatment chronic urethritis is stubborn, and requires unlimited patience and perseverance on the part of both sufferer and physician to carry out a methodical and necessary line of treatment.

URETHRAL SYNOVITIS, OR "GONORRHŒAL RHEUMATISM."

At any time during the course of an infectious urethritis or of any inflammation due to infection with the gonococcus, such as vulvitis, vaginitis, ophthalmia, etc., an acute rheumatoid inflammation of the joints may develop. There is considerable difference of opinion in regard to the etiology of this affection. By some authorities, chief among whom is Fournier, it is considered to be due to the specific cause of the gonorrhœa; while others, headed at one time by Guyon, consider it as merely an outbreak of a latent diathesis which becomes active under the depressing effect of the gonorrhœa. Finger states[1] that in a certain proportion of cases, characterized clinically by a mild course, the gonococcus has been demonstrated in the joints. Such cases are undoubtedly due to the conveyance of the gonococci through the blood into the joints. This same author goes on to state that recently Guyon and Janet found micro-organisms in the pus of three arthritides, and regard such cases as the result of ptomaïne-poisoning.

As a complication of infectious urethritis urethral synovitis is a decidedly rare affection, its frequency of occurrence being estimated at only 2 per cent. of all cases. It rarely comes on before the third week after infection, and is chiefly found in cases of posterior urethritis and where the urethral or vaginal suppuration has persisted for a considerable time;

[1] *Op. cit.*

with every subsequent reinfection it is apt to recur, and may then make its appearance with the onset of the inflammatory symptoms.

It is somewhat unusual for more than one joint to be affected, and in nearly two-thirds of the cases this joint is the knee; the other joints which may be affected in the order of their frequency are the ankle, the wrist, the finger-joints, the elbow, the shoulder, and the hip.

The **symptoms** often resemble so closely those of ordinary acute articular rheumatism that in the absence of a history of urethritis or other gonorrhœal infection the diagnosis is most difficult; the monoarticular nature of gonorrhœal rheumatism—together with the fact that it does not yield to the usual antirheumatic remedies, and has a tendency to become chronic and subacute—are the chief distinguishing features of this form of arthritis. The onset of symptoms is usually abrupt, although there may be prodromal pains in the joints; when once the joint is affected it swells rapidly, and becomes hot, tender on pressure and motion, and usually somewhat flexed, due to the exudation within the joint; during this acute inflammatory stage there may be slight fever, never, however, of as high a grade as in ordinary acute rheumatism. The acute painful symptoms usually subside in the course of a few days, but the swelling and stiffness of the joint persist in a more or less subacute form, and increase or decrease with every exacerbation or remission of the urethral discharge. Bony ankylosis or suppuration may occur, but is rare.

Treatment.—The usual antirheumatic remedies are of no avail, either in warding off the disease when there is a tendency to it or in curing it when it has once developed. The best prophylactic treatment is the employment of the urinary antiseptics—salol, boric acid, benzoic acid, and quinine. During the acute stage antiphlogistics will probably prove palliative and soothing, but not curative. In subacute and chronic cases warm compresses, massage, and the internal administration of iodides may be recommended. There are few cases which will not be benefited by full doses of salol. Full doses of quinine, with small doses of mercurials, have often given me most satisfactory results in these obstinate conditions.

Gonorrhœal Infection of the Female Genital Organs.

Infection by the gonococcus does not cause pain and annoyance in women to the same degree as in man, but the disease in its extension and sequelæ is farther-reaching and more dangerous. The gonococcus may attack primarily the vagina, the vulva, the urethra, or the uterus, and may spread secondarily to the Fallopian tubes and to the ovaries. It is extremely difficult to decide in which of these localities the infectious inflammation is most frequently found; perhaps the first in order of frequency is, as in men, the urethra; next is the mucous membrane of the cervix, then the uterus, and finally the Fallopian tubes. Vaginitis, at least where it is due to the gonococcus, is extremely rare, excepting in children. Vulvitis is not uncommon, and is often attended by inflammation of the glands of Bartholini.

Frequency.—Noeggerath states that 80 per cent. of women are affected with gonorrhœa; of 1930 women attending Sänger's clinic, the

percentage of cases of gonorrhœa was 12. In neither of these estimates is there any distinction drawn between prostitutes and reputable women —an important distinction to be regarded in any computation of the frequency of the disease. Inasmuch as the majority of prostitutes are affected with it in either the acute or the chronic form, any percentage which includes them would be misleading in so far as it relates to the spread of the disease, and all calculations in that respect must be based on the number of reputable women infected. For many reasons this number is extremely difficult to compute; the disease, even in its acute stage, may be attributed by the patient to a cause no more serious than a cold or a strain or an irregularity of her catamenia; no physician is consulted and all treatment is neglected. Such cases are probably numerous, and of them no record can be made. Cases which do come under observation usually arise from infection from husbands, who are themselves suffering from gonorrhœa or from chronic urethritis the result of an imperfectly cured attack of gonorrhœa of long standing: it is not generally recognized that in cases of chronic urethritis the gonococcus may retain its activity for two or three years.

Contagion.—This disease may be acute, subacute, or chronic. It is usually imparted by immediate contact during coitus. Mediate contagion may result possibly from bathing-water, garments, towels, etc.; to this contagion women are more liable than men, and to it is to be almost always attributed the disease in female infants, where the disease of the genitals is sometimes derived from gonorrhœal ophthalmia. Immediate contagion is generally imparted, in the case of infants, by the genital tract of the mother, and only very rarely by criminal practices.

The discharge of acute gonorrhœa usually causes acute gonorrhœa, although there can be no doubt that an inflammation equally acute may be started during coitus from a chronic gonorrhœa in the male.

The **symptoms** of acute gonorrhœa begin as acute vulvitis and urethritis; in children and young girls there is also an acute vaginitis, which is extremely rare in adults. The patient has a sense of heat and burning about the genitals, a profuse purulent discharge, ardor urinæ, urgency and frequency of urination. Should the uterine mucous membrane be involved, there are usually marked constitutional symptoms, such as fever and depression, and also severe pain in the uterine region, swelling of the womb and bloody purulent discharge from it. Not infrequently perimetritis complicates this uterine inflammation. Should the inflammation extend to the mucous membrane of the Fallopian tube, salpingitis and peritonitis may result. An examination shows the mucous membrane of the vulva, and occasionally of the vagina, infiltrated, reddened, and eroded. Pus can be caused to exude from the urethra.

SUBACUTE GONORRHŒA, which is generally a sequel of chronic gonorrhœa, is rarely revealed by persistent typical symptoms. There are intermittent attacks of ardor urinæ, frequency of micturition, disorders of menstruation, pelvic pains, and disturbances in the uterine functions, as is shown by dysmenorrhœa, by sterility, by aborting, and by attacks of perimetritis, of salpingitis, of ovaritis, or of local or general peritonitis; and the patient gradually glides into typical neurasthenia. An examination usually shows a catarrhal condition of Bartholini's

glands and of the periurethral follicles; there is a purulent secretion from the cervical canal, which is at times eroded; the uterus is enlarged, tender on pressure, and from attacks of perimetritis becomes fixed in its abnormal position; the ovaries and tubes are often enlarged, displaced, and fixed.

Diagnosis.—The symptoms of an ordinary acute case are almost characteristic; the presence of gonococci at once determines the character of the attack.

The subacute form is sometimes extremely obscure, and there may be no gonococci present. Sänger emphasizes the need of a careful search for the symptoms of acute or chronic gonorrhœa present in the husband or of a supposed recovery by him from a previous attack. Gonorrhœal ophthalmia in the child is suggestive of gonorrhœa in the mother. Items of diagnostic import are—a history of uterine catarrh without obvious cause, disease of Bartholini's glands, and, especially, a redness of the skin about their ducts, condylomata, a muco-purulent discharge from the cervix, without erosions or pseudo-erosions of the os, disease of the adnexa or of the pelvic peritoneum. In so far as these various diseases represent forms of mixed infection, many of them may be undoubtedly due to other germs than the gonococcus.

URETHRITIS.—The urethra is nearly always affected, which is in itself a valuable diagnostic as to the nature of the inflammation. The acute stage is brief, and, as compared with urethritis in the male, is of moderate severity; it is also less liable to become chronic, or if it should become chronic the symptoms are so slight that they are readily overlooked, and consequently the frequency with which the urethra is attacked is liable to be under-estimated.

Symptoms.—In both sexes these are much alike. The incubation varies from a few hours to five or six days; longer than this is exceptional. Slight tickling or burning sensations on urination, a purulent discharge, so scanty as to be detected only by pressure from behind forward on the urethra,—these, together with a swollen, œdematous urethral orifice, are often the only symptoms noticed by the patient, though at the beginning of the attack there will be, in hypersensitive women, rigors, slight fever, and general malaise. Even these symptoms may disappear in a few days or in two or three weeks, and the disease is regarded as cured. Finger states that it becomes chronic in women much more frequently than in men, because more subject to exacerbations, and even months after the original attack it often excites a urethro-cystitis, whereof the symptoms and course are much alike in both sexes, except that in the female it is less severe and more amenable to treatment.

Chronic urethritis rarely excites symptoms sufficiently characteristic to suggest, without a thorough examination, a probable diagnosis. This examination should be made after the patient has not urinated for several hours. Pressure from behind forward on the urethra may show that this tube is somewhat thickened and somewhat sensitive, and will usually press out a thin, milky, muco-purulent drop. Where the discharge does not amount to even this, the vulva and vagina are carefully washed and the two-glass test is applied; clap-shreds and pus will be found in the first glass; if in the second glass pus is discovered, chronic cystitis is usually indicated. In both sexes the urethra contains many follicles

which are subject to gonorrhœal inflammation, and form small tender tumors which commonly discharge their contents into the urethra. Two follicles there are particularly liable to become infected. Both are situated in the lower urethral wall and open just within the external meatus, and into them a fine probe can be inserted to a depth of a half to three-quarters of an inch. Should these follicles become acutely inflamed and their urethral openings firmly blocked for a time, they may cause urethro-vestibular or urethro-vaginal fistulas. In addition to these two deep follicles there is a number of smaller ones situated about the meatus. Any or all of them may become inflamed, rendering the urethral opening unsymmetrical, and finally rupturing, only to again fill up and discharge. The frequency with which these follicles are involved in gonorrhœal inflammation makes diagnosis particularly important. A careful examination usually shows at once the true nature of the case, since immediately after the urethra has been washed clean by the act of urination pressure will cause exudation of pus; moreover, on direct examination the patulous inflamed openings of the follicles can generally be found. This form of folliculitis, when chronic, yields no symptoms whatever; when acute, it causes a swelling deforming the urethral opening, free suppuration, and local redness. After the evacuation of pus there is rapid healing, but it is followed by a relapse.

An endoscopic examination of cases of acute urethritis in women shows redness, swelling, and general acute congestion of the mucous membrane. In chronic cases redness and erosions, sometimes comparatively deep, are observed, especially about the opening of follicles. The main factor in the diagnosis of acute urethritis is the presence of the gonococcus. In order to distinguish in chronic cases between urethritis and cystitis a careful examination of the water which has been retained for several hours should be made after washing out any discharge from the urethra, the vagina, or vulva; if the urine then passed contains pus, the inflammation is of the bladder.

The **prognosis** of urethritis is much more favorable in women than in men. The disease lasts but a short time, and even in those forms which in men become chronic it occasions no trouble, and heals of itself, without producing any serious or permanent alterations in the urethral mucous membrane.

The **treatment** of acute urethritis is governed by the same principles in both sexes. The diet is regulated; the urine is rendered unirritating by the administration of potassium citrate or sodium bicarbonate and by an abundance of water. Balsams may be given from the first, and as soon as the acute symptoms subside injections are to be employed. These should be thrown in by the ordinary clap-syringe, but not more than a drachm at a time. The solutions may be slightly stronger than those used for males. As soon as the acute stage is passed, the lesions are determined by the urethroscope, and are treated directly with iodine in 2 to 10 per cent. solution, or silver nitrate 1 to 10 per cent.; these are applied by cotton tampons or brushes only to the inflamed spots. When gonorrhœal inflammation involves the follicles at or near the meatus, it is cured only by the destruction of the follicles, which is attained either by a finely pointed stick of nitrate of silver, by the electric needle, or by galvano-cautery.

Stricture of the Male Urethra.

Congenital stricture within the meatus is an extremely rare anomaly; only a very few thoroughly trustworthy cases have been observed. Delfau reports[1] that Nélaton had observed 4 cases in which the strictures were deep within the penile portion of the urethra, and in 1 case as deep as even the bulb. Another case is reported by Jameson where three plainly perceptible strictures were found in a boy of ten.[2] Cases cannot be relied upon, however, which are reported as occurring after the first year or year and a half of life; the chances that the stricture is acquired, and not truly congenital, increase with every succeeding year. Decided narrowing of the meatus is by no means a rare deformity; but unless it is an extreme case the symptoms are usually not sufficiently marked to necessitate surgical intervention until some subsequent urethral lesion necessitates the introduction of instruments.

Whenever the condition causes reflex irritation of the bladder or symptoms of obstruction to the flow of urine, meatotomy should be performed, enlarging the meatus to the normal calibre of the urethra; but if the operation is not done with considerable caution there is a risk that the cure will be worse than the disease, and result in an artificial hypospadias of the glans.

Acquired stricture, where the normal calibre and possibility of distention of the urethral canal are in certain places perceptibly diminished, is a result either of disease or of injury; with this condition are always associated changes in the mucous membrane, or in the submucous or muscular tissues which form the urethral walls.

In general terms, strictures may be classified as (1) inflammatory; (2) spasmodic; (3) organic, including those of large calibre and those of small calibre. The first two classes are, however, strictly speaking, not true strictures; they are only temporary contractions, and are not due to any cellular change in the mucous membrane or underlying tissues of the urethral walls.

(1) The possibility of a stricture wholly due to inflammatory swelling is doubtful in the opinion of numerous authorities, who maintain that inflammatory swelling of the mucous membrane unaccompanied by congestion of the prostate or by muscular spasm is not capable of producing retention of urine; while this is, in the main, true, it is none the less an undoubted fact that in cases of acute anterior urethritis there is a decided diminution in the force and calibre of the stream of urine even when the prostate remains healthy and there is no pre-existing organic stricture of the canal; such diminution in the size of the stream must therefore be solely due to the approximation of the urethral walls from inflammatory swelling. When this condition persists after the acute symptoms have subsided, as has already been mentioned in the section on Chronic Urethritis, it is probably the earliest stage of the organic stricture. Culver and Hayden have suggested[3] that, instead of being called inflammatory stricture, the condition should be described as an "acute catarrhal inflammation involving temporary swelling of the mucous membrane," and this description would furnish a much clea

[1] *Maladies des Voies urinaires*, Paris, 1880, p. 241.
[2] *Epitome of Practical Medicine*, April, 1887.
[3] *Venereal Diseases*, 1891, p. 88.

idea of the existing pathological conditions. These obstructions always subside with the acute inflammation from which they arise; the treatment is therefore included in that of urethritis.

(2) Spasmodic stricture is due either to reflex irritability or to a muscular contraction brought about by psychical causes, such as anxiety, shame, or fear. Reflex irritation of the involuntary muscular fibres or of the compressor urethræ usually arises from an abnormally sensitive portion of the pendulous or of the bulbous urethra, such as, for instance, a patch of granular urethritis or an organic stricture close to the meatus. Occasionally the centre from which the reflex irritation arises is situated beyond the spasm—that is to say, in the bladder, rectum, or anus; it is also possible that the retention which often follows operations on the genito-urinary organs or the rectum may be mainly due to vesical inhibition; but a forcible argument by analogy in favor of its being due to urethral spasm is the fact that retention, which occasionally follows parturition, may be entirely overcome by wide dilatation of the urethra. Congenital constriction of the meatus is a condition which is considered by many to be a frequent cause of spasms of the urethra, and a permanent cure is attributed to meatotomy. It is to be remembered, however, that the most frequent subjects of urethral spasm are nervous and excitable young men, on whom any operation has a decided effect *per se;* the simple passage of a catheter or sound will often work quite as effective a cure as the division of the contracted meatus. If the meatus be too small to admit of the passage of a full-sized sound, meatotomy is always justifiable when there are otherwise inexplicable urinary symptoms.

ORGANIC STRICTURE occurs in either sex, but is only very rarely found in women; it is most frequent in men between the ages of twenty and forty-five. Of the two causes, disease or injury, the former in the shape of urethritis is by far the most common. Whether or not a urethritis will be followed by a stricture depends largely, but not wholly, upon the virulence and duration of the inflammation; a very potent predisposing cause for the formation of stricture following urethritis is the violence and persistence of chordee during the acute stages of the urethritis. The stretch to which the mucous membrane is subjected during the painful erection of the penis frequently causes minute ruptures, which are constantly irritated by the passage of the urine. The mode of attack of the gonococcus is in itself what might be reasonably supposed to be a sufficient cause of stricture in all cases of infectious urethritis. The tendency of this organism when it invades the urethra, to penetrate first to the follicles and mucous glands, and then gradually as the inflammation subsides to migrate toward the surface of the epithelium, appears to be very favorable to the formation of firm cicatricial contractions extending deep into the submucous tissue and greatly reducing the normal elasticity of the parts. It is, however, by no means the universal rule that infectious urethritis is followed by stricture.

Harrison has called attention to the fact that the inflammatory exudation which takes place in cases of chronic granular urethritis is a misdirected effort of nature to overcome the constant slight infiltration of urine which would otherwise occur at the places where the epithelium is abraded; these plastic bands of lymph, thrown out to strengthen the urethra at its weak points, at the same time act as hindrances to the

normal distention of the canal; furthermore, an additional stimulu the exudation of plastic lymph round the urethra is probably the le age or exosmosis of some of the constituents of urine through the w of the canal.[1] This same author also states that the mucous membr is usually only secondarily involved, and that this plastic inflammat exudation is remarkable for its degree of density and tendency to c tract. Of all strictures, those found in connection with lacerations ruptures of the urethra, owing to their being constantly subjected to irritation of the urine during the process of healing, are the most res ing and contractile. Oberlander, according to Fordyce,[2] maintains t the form of chronic urethritis in which the glands of Littre are dec edly affected, and in which extensive cicatricial bundles project hi above the mucous membrane, most frequently results in stricture. T term "chronic contracting periurethritis" has been suggested by Br son[3] as best describing the condition of urethral stricture. In justi cation of this term may be mentioned the disease which is described Buckston Browne as occurring in elderly men who are obliged to use catheter frequently, and to which is given the name "catheter stri ture." At the depth of four or five inches the urethra appears to be a state of spasmodic contraction and the mucous membrane loses i normal polish; in addition to the inflammatory exudation which u doubtedly exists in the mucous membrane, there is also probably persistent leakage of urine through the mucous membrane, whic gives rise to periurethral inflammation and plastic exudate.

The length of time which it takes for a stricture to develop depen largely upon the nature of the cause: the inflammatory exudate and t gradual leakage of the urine following infectious urethritis seldom pr duce stricture before one year after the subsidence of the urethritis, b after a laceration or rupture of the urethra the process of stricture-f mation of course begins with the cicatrization of the urethral wou In an examination of 164 cases of stricture Thompson found only which had developed during the stage of acute urethritis; in 71 the stricture came on in one year after the urethritis; in 41, three to f years; in 22, in seven to eight years; and in 20, in twenty to twen five years after the urethritis. Hill,[4] basing his opinion on an exami tion of 140 cases of stricture from all causes, maintains that the mini mum of time in which strictures develop after infectious urethriti two years and the maximum is thirteen years; after urethral cha from ten months to three years; after injury, from four to eigh months. He refers here to the permanent stricture, and not that w arises soon after the injury, and which is due merely to local œdem effusion of blood. Guyon found the greatest number of stricture occur four to ten years after the urethritis.

Traumatic stricture, as has been mentioned above, is the most firm obstinate of all: it may arise after any injury to the urethra which volves only a portion of the thickness of its walls. The rapidity w which the stricture forms after an injury of course depends upon depth of the laceration; thus, after abrasions of the mucous membra from the careless or clumsy use of urethral instruments, strictures m

[1] *Lettsomian Lectures*, 1888.
[2] *Journ. of Cut. and Gen.-urin. Dis.*, Jan., 1889.
[3] *Ibid.*, June, 1889.
[4] Quoted by Keyes: *Genito-urinary Diseases*, p. 1

not form for many months, while after injuries from blows and falls on the perineum or from forcible bending of the penis during erection a stricture may follow in the course of five to eight weeks. Masturbation is asserted by many authorities to be a frequent cause of stricture, but the difficulty of eliminating every other possible cause, such as the laceration of the urethra by the introduction of foreign bodies from erotic impulses, attacks of urethritis long antecedent, etc., together with the fact that repeated examination of the inmates of prisons and asylums, where masturbation is almost universally practised, fails to show that stricture is any more prevalent than in a corresponding number of men among whom the practice is not the rule, makes its etiological importance a matter of much doubt.

Organic strictures vary in depth from those which only involve the thickness of the mucous membrane to those which extend deep into the submucous layers and even penetrate the meshes of the corpus spongiosum. In extent they vary from a narrow cord-like band, a "linear stricture," to one involving two or three inches of the mucous membrane and converting the urethra into a devious, unyielding channel; this variety is called the "tortuous stricture." Intermediate between these two varieties in extent is what is known as the "annular stricture." Strictures may also be classified according to their physical properties; as, for instance, when they bleed easily from the least surgical interference they are classed as *irritable;* or when they are elastic and return at once to their former size after being dilated they are classed as *resilient* strictures. They are also, frequently and somewhat arbitrarily, spoken of as strictures of large calibre and strictures of small calibre: the former admit instruments of larger circumference than 15 millimetres, and the latter admit only instruments under that circumference.

The pathological significance of strictures of large calibre has undoubtedly been somewhat over-estimated; if examinations of the urethra be made with the urethrameter, strictures of large calibre can be discovered in every case. The scale of relations which Otis[1] gives between the circumference of the penis and the calibre of the urethra, while it undoubtedly represents quite accurately the distensibility of the urethra, fails to take into account the fact that there are points of physiological narrowing, notably along the course of the pendulous urethra. Delpet's elaborate experiments show that there is invariably a narrowing of the penile urethra at a point one to three inches from the meatus. The next least dilatable region is near the prepubic angle.[2] Guyon wisely emphasizes the distinction which must be made between the true calibre of the urethra and its distensibility.[3] The urethra is a canal only when traversed by a stream of urine or by an instrument, and when it is not so distended its walls collapse in longitudinal folds; the true calibre is therefore shown only by separating its walls without stretching them.

As there is no portion of the human anatomy to which inflexible rules of proportion can be applied, it is unwise to follow implicitly any standard of size of the internal structures based on the outward appear-

[1] *Stricture of the Male Urethra*, p. 89.
[2] *Ann. des mal. des Org. gén.-urin.*, Mar., 1892, p. 196.
[3] *Leçons cliniques*, Paris, 1881, p. 680.

ances or measurements. It is, however, not against the use, but against the abuse, of Dr. Otis's table of relationships and his instrument for measuring the calibre of the urethra that I argue. In order to be on the safe side, I suggested[1] years ago that a scale somewhat lower in the grade of numbers than Otis's should be adopted; this scale is as follows: A penis 3 inches in circumference at the middle of the spongy portion indicates a urethra which should normally admit an instrument of about 26 to 28 millimetres in size; when it is 3¼ inches, the urethra should have a calibre of 28 to 30 mm.; 3½ inches, 30 to 32 mm.; 3¾ inches, 32 to 34 mm.; 4 inches, 34 to 36 mm.; beyond which size it is seldom necessary to go. By this smaller scale the probability of mistaking physiological narrowing for stricture is greatly diminished, and, moreover, when an examination discloses a distinct contraction within the limits of this scale, and when at the same time there are present definite symptoms, such as gleety discharge, frequent urination, followed by dribbling of urine, etc., the case may with propriety be considered as one of organic stricture.

The most frequent location for stricture is in the bulbo-membranous portion, which includes a space extending from about one inch in front of the anterior layer of the triangular ligament to the prostato-membranous junction; next in frequency is the first two and a half inches of the urethra from the meatus. The frequency with which these two regions are affected with stricture depends largely upon the fact that they are highly vascular portions of the urethra, and also that they are more frequently the seat of chronic inflammation. Owing to bony and ligamentous surroundings, it is in the membranous portion of the urethra that lacerations and ruptures most frequently occur; consequently this portion of the canal is more often than any other the seat of traumatic strictures. The chief differences of opinion with regard to the most frequent seat of stricture depend upon the conception of what a true stricture is, and upon the method used to demonstrate its existence; thus, Sir Henry Thompson's examination of 320 museum preparations in which he found stricture of the bulbo-membranous region in 216 (or 67 per cent.), and in 54 specimens stricture within two and a half inches of the meatus, and in 51 (or only in 16 per cent.) stricture in the intermediate spongy portion, gives an idea of the localities of stricture very different in frequency from that obtained from the examinations made by Prof. Otis with the aid of the urethrameter. Of the 258 strictures examined by the latter, 115 were found in the first inch and a quarter, 129 between one and a quarter and five and a half inches from the meatus, and only 14 between five and a quarter and seven and a quarter inches: that is in the bulbo-membranous region. It is highly probable that many of these "strictures" were points of physiological narrowing. Strictures never occur in the prostatic urethra.

Changes in the Urethra.—Behind the stricture the urethral walls become somewhat thinned, and the canal is therefore relaxed and pouched; the mucous membrane is usually deeply congested, and from the irritation of the retained urine it soon becomes eroded, possibly even deeply ulcerated. As the loss of substance increases, the urine is apt to leak through into the spongy tissue, especially toward the floor of the canal, and abscesses followed by urethral fistulæ result. A second pouch some-

[1] *International Encyclopædia of Surgery.*

times forms in front of the stricture, but in this portion of the canal the mucous membrane does not show the same marked signs of inflammation. The formation of this second pouch is due to the retrograde metamorphosis of the anterior portion of the stricture, which is not exposed to the continual irritation of the urine, and consequently undergoes absorption. Such changes do not take place invariably in all urethras which have become strictured, nor do all strictures contract with the same degree of rapidity; the differences depend upon factors which cannot always be accurately estimated—namely, the irritant qualities of the urine, the amount of vital resistance of the tissues, and the degree of compensatory hypertrophy of the bladder, etc. The process may remain stationary for a long time, but the tendency is toward persistent contraction.

From the direction in which the stricture-formation usually advances —namely, from the floor of the urethra upward—it has a tendency to push the normal aperture of the canal in that direction; therefore the opening through a stricture will usually be found near the roof; an opening through the centre of a stricture is exceptional, but it may be found at any point on the circumference. Complete obliteration of the canal very rarely occurs except in cases of severe laceration or complete rupture; these absolutely impermeable strictures only form where there are fistulous openings for the escape of the urine. In one case reported by Peso[1] a fistulous tract around the cicatricial tissue maintained a passage for the urine; it was probably the result of a false passage.

Symptoms.—*Alterations in Micturition.*—1. *Frequency.*—The altered relation between the expulsive force of the bladder and the resistance which the stream of urine meets in the urethra, and then the extension backward of the inflammation, producing cystitis and possibly atony of the bladder-walls and retention of residual urine, always produce a sufficient degree of vesical irritation to cause frequent and often imperative urination. According to Fenwick, there is not uncommonly an amount of residual urine far in excess of what might be expected. The frequency of urination is seldom troublesome at night.

2. *Character of the Stream.*—In tight strictures the stream of urine is much reduced in size and the force is considerably diminished—not so much, however, as might reasonably be expected, as the compensatory hypertrophy of the detrusor urinæ is almost always sufficient to counteract the obstruction. The twisting and forking of the stream depends more upon the shape and calibre of the meatus than upon any constriction farther back in the canal; it is therefore a symptom of little value. Only late in the disease, when vesical atony has followed the hypertrophy just mentioned, does diminution of expulsive force become a noticeable symptom.

3. *Dribbling after urination* is due to the imperfect expulsion of the urine from the urethra after the bladder has been emptied; a few drops are retained behind the stricture and gradually leak through the narrowed channel by the force of gravity. The incontinence of retention is a late symptom associated with a decided degree of atony of the bladder following retention. Incontinence of urethral origin depends upon the dilatation of the urethra behind the stricture, which converts that part

[1] Tadriatte: *Dict. des Sciences méd.*

of the urethra into a pouch of the bladder, and the pressure of the urine therefore rests upon the stricture, which, being not absolutely impervious, allows small quantities of urine constantly to filter through. This form of incontinence is not so noticeable at night, when by the position of the patient the weight of the column of urine does not press upon the stricture, as it is in cases of retention from prostatic hypertrophy, where the escape of the urine is due to the over-distention of the bladder and the relaxation of the natural sphincter and irritation of the prostatic urethra.

4. *Ardor urinæ* is not usually present unless there is considerable prostato-cystitis.

5. *Retention* may occur long before the stricture has become sufficiently dense to offer a decided impediment to the flow of urine; in this event the closure of the canal is due to the inflammatory swelling and congestion of the mucous membrane behind the stricture. It may be a late symptom, and depend entirely on the obstruction offered by the stricture. The chances for the occurrence of retention are always increased by fatigue or cold or by alcoholic or sexual excesses.

6. *Vesical tenesmus* due to stricture usually persists throughout the act of micturition; in distinction to this, the tenesmus produced by prostatic hypertrophy begins to lessen as soon as the urine starts to flow; in cystitis it is worst at the close of the act.

7. *Urethral Discharge.*—There is considerable difference of opinion in relation to the constant appearance of this symptom. On the one hand, it is said that a gleety discharge is an invariable accompaniment of all strictures; on the other hand, Janin states[1] that out of 61 cases of stricture which he examined, urethral discharge was found in only 4. From personal observation about 50 per cent. of strictures are accompanied by a gleety discharge; in the other 50 per cent. a careful examination of the urine will almost always disclose the presence of pus-corpuscles and epithelial shreds. It is most probable that the majority of those cases reported as gleet with stricture of large calibre are merely cases of chronic granular urethritis.

8. *Interference with Coition.*—The physiological congestion is almost always increased, but coitus is apt to cause considerable pain from distention of the urethra with semen retained behind the stricture. After coitus the semen dribbles away slowly for some time. From the hypersensitive condition of the deep urethra ejaculation is often premature, or else erection is imperfect and subsides during the act.

9. *Constitutional disturbances* are seldom if ever met with, unless there is septic involvement of the bladder and kidneys, when the symptoms will be those of either uræmia and sapræmia or of septicæmia.

The diagnosis made from the subjective symptoms should always be confirmed by a urethral examination, which can be usually most accurately made by means of the so-called bougies à boule. The most serviceable kind of these acorn-tipped instruments is that made of flexible India-rubber. It is very important that the acorn-tip of the instrument should meet the shaft at nearly a right angle, so that it will readily catch on the edge of the stricture as it is withdrawn after having passed through the narrowed portion of the canal and slightly dilated it by

[1] *Dict. des Sciences méd.*

means of the conical point. The proper size of instrument is judged approximately by the scale of relationship (given above) between the circumference of the penis and the calibre of the urethra. If the meatus will not admit an instrument of sufficient size, it must be enlarged by cutting down on the floor of the urethra until the explorer will pass freely. In order to ascertain the extent of the stricture, as well as its position, the depth of the first resistance felt should be noted on the shaft of the instrument, and as soon as it is released from the constriction and passes more freely along the urethra the distance from the handle of the instrument to the meatus should be again noted; by this means a fairly accurate knowledge of the position and extent of the stricture may be gained. When bougies à boule are passed into the bladder and withdrawn slowly, the bulb of the instrument almost always catches on the point of normal resistance offered by the posterior layer of the triangular ligament. The resistance met with at this point was for some time considered by eminent authorities to be a pathological condition which, in the absence of other obvious cause, they attributed to the effects of masturbation; the true nature of the constriction was, however, proved beyond peradventure to be as above stated (White). It very often happens that when a bougie à boule, even of small size, will not pass through a stricture, a steel sound several sizes larger will pass with ease. Steel sounds, although occasionally useful for diagnosis, can never give as accurate information as bulbous instruments.

The determination of the location, extent, and calibre of the stricture by means of instrumentation is generally as much as it is wise to attempt at the first visit, lest the already sensitive urethra be still further irritated.

The **results** of stricture other than the local changes in its immediate neighborhood are those which follow from the abnormal pressure of urine back of the stricture in the urethra, in the bladder, in the ureters, and finally in the kidneys. The urethral mucous membrane becomes thinned, eroded, and finally may become pouched; or, weakened by the formation of numerous small abscesses, it may give way entirely and permit extensive extravasation of urine. The overlying parts become œdematous and dusky red in color, sometimes emphysematous from the gases evolved by the decomposition of urine; finally, spots of gangrene develop and extensive sloughing takes place. There is always associated a condition of general septicæmia or uræmia.

The **course** taken by the infiltrating urine will indicate as follows the point at which the urethra has given way: In all that part from the meatus to the scrotal curve extravasation is accompanied by swelling of the penis, greatest in the immediate neighborhood of the point of escape. In the region included between the attachment of the scrotum and the anterior part of the bulb the course of extravasation is governed by the attachments of the deep layer of the superficial fascia or the fascia of Colles. From the bulbous urethra the urine follows the space enclosed by this fascia in front and below, and by the anterior layer of the triangular ligament posteriorly; from this space, therefore, owing to the attachments of the fascia, it is directed into the scrotal tissues, and thence up between the pubic spine and symphysis, until it reaches the abdomen. When it escapes from the membranous urethra it is confined to the space

included between the layers of the triangular ligament, and only gains access to the outer parts after suppuration and sloughing have given it an outlet.

The constant pressure exerted from within has the effect upon the bladder of first producing a compensatory hypertrophy; this is followed by a thinning of the walls between the muscular trabeculæ, and finally by the formation of numerous sacculations which communicate with the cavity of the bladder by narrow apertures, and which often contain decomposing urine and calculi.

The ureters at the same time become dilated, partly from the backward pressure of urine from the bladder, and partly from the compression of their vesical ends by the frequent acts of urination; soon the septic process from the bladder spreads up the dilated ureters, the kidneys become infected, and the condition of "surgical kidney" ensues.

The **prognosis** in relation to the fatality depends, of course, upon the stage of the disease and the extent of the secondary organic changes which have taken place. Relief of the obstruction, drainage, and antisepsis of the bladder, together with the proper hygienic measures, often result in wonderful improvement in apparently hopeless cases.

Treatment.—(1) Strictures of large calibre in the bulbo-membranous region are best treated by gradual dilatation with a conical steel sound. The method of introduction of the steel sound has been fully described in the first part of this section; it is therefore not repeated here. The use of the sound is always followed by a slight exacerbation of the symptoms, and possibly after the first dilatation by a slight increase in the urethral discharge; until these symptoms subside, which is usually in two or three days, the instrument should not be reintroduced. If the introduction of the same-sized instrument at the second visit causes considerable pain or bleeding, it is best not to increase the size at once; otherwise an advance of one or two numbers of the French scale may be made at each subsequent visit. When a full-sized instrument has been passed (full-sized meaning the largest size as indicated by the scale of relationships between the penis and the urethra), the gleety discharge, the undue frequency of urination, and the other symptoms of urethral constriction and inelasticity generally have disappeared, and it is only necessary then to maintain the degree of dilatation which has been gained by the passage of the instrument at longer intervals; at this stage of the treatment it is generally safe to entrust the use of the sound to the patient, who should be instructed to pass it at least once a week for a period of six months.

The method of gradual dilatation is, on the whole, the safest and best method of dealing with these strictures of large calibre in the bulbo-membranous region; the advocates of internal urethrotomy often ignore the dangers of the operation—dangers not so much to life as of serious deformity of the penis, of excessive hemorrhage, or of loss of expulsive power, causing dribbling after urination; all of these results have been known to occur after extensive urethrotomy.

(2) Strictures of large calibre in the pendulous urethra may be treated by internal urethrotomy with much greater safety, and apparently with much greater chance of success, than those in the locality just described. The differences of opinion which exist in regard to

strictures in this region have reference to their pathological significance and frequency of occurrence, rather than to the treatment proper for them.

The varieties of stricture which most obviously indicate the cutting operation in this portion of the urethra are those of long standing, those distinctly fibrous in character, and, especially, resilient or non-dilatable contractions. There is, however, a slight percentage of mortality for the cutting operation even in this locality; Stein estimates the mortality to be from 2 to 5 per cent.[1] Thompson had 6 deaths in 430 operations. At the least estimate there are always two chances in the hundred of losing the patient; there should be, therefore, indisputable reasons for adopting this operation in preference to dilatation by means of steel sounds—an operation entailing scarcely any risk. It is not in accord with other pathological observations to suppose that the mere division of a dense and old contractile band of fibrous tissue will result in its absorption; it is most probable that the majority of true strictures of the spongy urethra which are cured by internal urethrotomy are those in which the division of the stricture is supplemented by the use for some time of full-sized bougies. I have expressed my views on this subject somewhat fully elsewhere,[2] but, as I have since then seen no reason for changing them, I will repeat them here. I am compelled to believe, on both clinical and pathological grounds, that the great majority of so-called strictures of the pendulous urethra which are cut by the extremists in urethrotomy are points of physiological narrowing, and that the so-called "cures" are merely illustrations of the fact that by a linear incision in its long axis we can put in the normal urethra a longitudinal splice of fairly healthy tissue which has but little tendency to contract afterward, and can thus more or less permanently enlarge the urethral calibre. This fact also explains the freedom from fatal results claimed by some surgeons, who find strictures and perform urethrotomies in the great majority of their cases of chronic urethral discharge. As there has been no real interference with the genito-urinary functions, there can be no development of renal or vesical disease, and the urethra can be operated upon and a splice introduced with comparative impunity.

It is difficult to see, however, why such a splice should prevent the steady contraction of a mass of old cicatricial tissue, such as occupies the wall of the canal and the periurethral space in strictures of long duration.[3]

In patients from the poorer classes, where strictures are more often neglected, the operation is indicated with much greater frequency than in well-to-do private patients; among the latter perhaps not more than one in ten will require cutting; gradual dilatation, as above described amply suffices in the remainder to cause the disappearance of all symptoms.

(3) Strictures of the meatus are peculiarly unsuited for dilatation, owing not only to the pain which stretching in this region entails, but also owing to the intimate relation between the spongy tissue of the glans and the urethra. Almost absolute safety of the operation is the

[1] *Trans. Amer. Assoc.*, "Gen.-urin. Surg.," 1889.
[2] *International Encyclopædia of Surgery.*
[3] White: *Morrow's System of Gen.-urin. Dis.*, vol. i.

recommendation for cutting all strictures in this region. After the operation the meatus should be kept dilated for a week or more by the daily insertion of a meatus bougie or the tip of a large-sized urethral sound.

(4) Strictures of small calibre situated either at the bulbo-membranous junction or beyond it, and accompanied by a gleety discharge and marked vesical symptoms, are surgically the most important. Their diagnosis is made by means of a bulbous bougie or by introducing a sound down to their anterior surface. They may be treated either by gradual dilatation or by some form of urethrotomy; divulsion is at the present day almost entirely discarded by genito-urinary surgeons of any standing, so clumsy is it, so dangerous, and so uncertain withal; it will therefore receive no further mention here.

In beginning the treatment of these cases it is always advisable to attempt first to pass a steel sound through the strictures with great gentleness; no force whatever should be exerted, and it is not safe to use instruments below 8 or 10 of the French scale; even in the most experienced hands there is always danger of laceration of the inflamed and weakened tissues around the stricture and of the formation of a false passage. If a sound has been passed through the stricture, it should be allowed to remain for five or ten minutes, and then withdrawn. Further instrumentation should be postponed for from twenty-four to seventy-two hours; in the interim five-grain doses of salol or of boric acid should be administered every four hours, with a full dose of quinine night and morning. When surgical treatment is resumed, it is best to begin again with the same-sized instrument as was previously used, and after this one, two, or three sizes larger may be used in succession, provided that their introduction does not cause very marked pain. The occurrence of pain or hemorrhage is always an indication for increasing the intervals between instrumentations or for reducing the size of the instrument. Under this treatment, if the strictures be not resilient or irritable or of traumatic origin, the symptoms will generally disappear by the end of four to six weeks; for resilient, irritable, or traumatic strictures, or for those occurring in this region which cannot be dilated owing to the provocation of rigors, external perineal urethrotomy is the operation of choice.

Internal urethrotomy, in my judgment, should be applied in this region only in those cases in which the patient refuses to have the external operation performed. It is attended under the best skill with a mortality distinctly larger than any of the other methods, and there is no trustworthy evidence, which is to me convincing, that it is followed by any larger percentage of cures.

In a certain number of cases neither steel sounds nor rubber instruments can be made to enter the stricture, but perseverance with filiform bougies of whalebone will usually end in success. If the filiform bougie cannot be made to enter the stricture at the first trial, it should be withdrawn and the point bent up at an angle, so as to be able to reach the aperture, which may be situated at one side of the normal canal; if it still will not pass, another filiform bougie should be inserted alongside of the first, and then another and another until six or more have been inserted in the canal; by making trials with each one in turn, finally one will be found

which will slip through the stricture. If this fail or if one of the bougies can be made to penetrate the stricture to a certain distance only, but not pass through it, the instrument should be allowed to remain pressing against the obstruction, being tied in place for twenty-four hours, provided, of course, there is no excessive retention of urine. With retention-symptoms of very moderate urgency it may confidently be expected that urine will begin to dribble by the side of the instrument, and that a certain amount of relief will be obtained in a few hours.

After the first instrument is introduced in such a case there are four courses before the surgeon: 1. He may allow it to remain in place, with the certainty that in one or two days others may be slipped in alongside of it, and may be used as guides for the introduction of a tunnelled catheter, and later of an ordinary soft or steel bougie. 2. He may attempt to conduct a tunnelled catheter over it into the bladder at once, to be followed by gradual dilatation. 3. He may conduct over it a tunnelled and grooved staff, and then proceed to the performance of external perineal urethrotomy. 4. He may use it as a guide for a Maisonneuve urethrotome, and may immediately perform internal urethrotomy.

For absolutely impermeable stricture with retention of urine there is but one indication, and that is to relieve the distention of the bladder; and in this case the performance of external perineal urethrotomy is the operation best suited to the requirements.

Internal Urethrotomy.—The stricture may be divided either from before backward or from behind forward, and the cut may be made either upon the floor or in the roof of the urethra. Of the instruments devised to cut from before backward, that known as Maisonneuve's urethrotome, or rather Teevan's modification of it, is probably the best. This instrument[1] consists of a grooved staff which is introduced into the bladder. A triangular blade with a stylet attached is made to slide along the groove, and the blade is contained in a double sheath from which it is protruded when the stricture is reached. In Maisonneuve's original instrument the blade was furnished with a knob and the groove extended to the end of the staff. The groove in Teevan's modification terminates two inches from the end; it likewise is fitted with a wire stylet, on the withdrawal whereof urine will flow when the instrument is in the bladder. For the knob on the blade there is substituted a double sheath which encases the knife. The instrument terminates in a small screw, by means of which it can be attached to a conducting bougie which guides it into the bladder. Before making the incision it is of great importance to be quite certain that the instrument is really in the bladder, for, in the absence of such proof, a false passage might be divided instead of the stricture. After the instrument has been introduced the stylet is withdrawn, and the urine will then escape if the bladder have been reached.

The operation is performed in the following manner: A fine flexible bougie, equal in size to No. 4 or 5 French, is passed into the bladder as a guide, and to it is then screwed the staff or sheath of the urethrotome, which is passed through the stricture into the bladder and held in position by an assistant. The operator with his left hand draws the penis

[1] *Brit. Med. Journ.*, Sept. 20, 1884.

forward; with his right he pushes the stem of the sheathed knife down the urethra until the obstruction is reached; the knife is then protruded and all resisting tissue in front of it is divided. The incision is thus made in the roof of the urethra. The knife is then withdrawn into its sheath, which is pushed along the urethra to ascertain that the division has been complete. On withdrawing the urethrotome a full-sized gum catheter is passed, the urine withdrawn, and the catheter carefully tied in so it will just reach and empty the bladder. If it excites much complaint of pain, it should be regarded as prima facie evidence that it is too far within the bladder or is blocked or obstructed. The patient should be kept in bed for forty-eight to seventy-two hours, when the catheter may be withdrawn. Two days later a French bougie of the same size as the catheter should be passed. After this the urethra should be dilated with bougies every three or four days for several months.

Civiale's urethrotome was devised for cutting the stricture from behind forward. It consists of a straight shaft terminating in a bulb in which is concealed a small knife; by means of a sliding knob on the handle of the instrument this knife can be protruded. The bulb of the instrument is passed through the stricture, and the blade is protruded as it is withdrawn. If there be more than one stricture, the most deeply situated should be cut first, and then the blade closed and the instrument withdrawn until the shoulder of the bulb catches on the second stricture, which is then divided in the same way.

Another instrument designed to cut strictures from behind forward, at the same time putting them on the stretch, is that known as Otis's dilating urethrotome. It consists of a shaft in two longitudinal segments which can be separated by means of a screw on the handle of the instrument; one of these segments is grooved for the accommodation of the knife, which, when it is at the tip of the instrument, lies concealed in the groove; as it is withdrawn by means of the stylet attached to it an elevation in the floor of the groove pushes it beyond the circumference of the instrument and exposes its cutting edge. With this instrument the cutting is done in the roof of the urethra. The after-treatment is the same as that just described in connection with Maisonneuve's operation.

With reference to the proper site of urethrotomy, whether it should be performed in the roof or on the floor of the urethra, it may be stated that, in view of the fact that stricture-formation takes place chiefly on the floor of the canal, there is a greater likelihood of the formation of a splice of healthy mucous membrane if the roof of the canal in front of the bulb of the urethra be divided. So great is the danger of wounding large blood-vessels during urethrotomy in the deep urethra that the operation in this region is comparatively seldom performed.

The chief indications for the performance of internal urethrotomy in the penile urethra may be summed up as follows: When the stricture is of long standing and resilient, when it is extremely irritable, and when instrumentation causes dangerous rigors. Meatotomy may occasionally be required in order to pass the large instrument used in lithotrity.

External Urethrotomy.—The old boutonnière operation (of which

Cock's operation is a modification) consisted merely in opening the urethra behind the stricture; it was purely palliative, and did not of necessity include any division or enlargement of the strictured portion of the canal. Cock's operation consists in opening the urethra at the apex of the prostate behind the obstruction; the different stages of the operation are the same as those of median lithotomy, except that no grooved staff or director is previously introduced into the urethra.

Syme's operation, or external perineal urethrotomy with a guide, requires for its performance a grooved staff, whereof the curved terminal part (being somewhat less in circumference than the straight part of the shaft) forms a shoulder where the staff begins to curve; when in position this shoulder rests against the anterior face of the stricture. The groove of the staff runs to its extreme tip. The curved portion up to the shoulder is introduced through the stricture, and an incision is then made in the median line of the perineum, and the knife is so directed that its point shall hit the shoulder of the instrument. When the point of the knife slips into the groove on the staff, it is thrust forward toward the neck of the bladder until all of the stricture has been divided. A probe is then inserted into the bladder and the staff is withdrawn, and a catheter is then passed through the penile urethra and guided into the bladder by the probe or finger in the wound. If the point of Syme's staff will not pass through the stricture, a filiform bougie should be introduced, and over this a tunnelled catheter should be passed down to the stricture, which is then divided on the groove in the convexity of the course of the catheter.

Combined internal and external urethrotomy is occasionally practised where there is decided resiliency of the stricture or where there are urethral fistulas. First, the stricture is divided by means of a urethrotome, and then a staff is passed and the membranous urethra is opened in the perineum behind the stricture; a drainage-tube is then inserted and the bladder drained. The theory of this operation—viz. to give the urethra a complete rest while the wound inflicted by the urethrotome is healing, and also to allow the fistula to close—is surgically sound and the clinical results have been excellent.

Wheelhouse's operation requires for its performance a straight grooved staff terminating in a knob turned directly backward at the tip of the instrument; this staff is inserted in the urethra down to the stricture, and the urethra is then opened in the perineum a full quarter of an inch anterior to the obstruction. The staff is then rotated in the urethra and the knob protruded through the wound, so that it catches in its upper angle; the edges of the urethral wound are then held apart with blunt-pointed forceps, and the operator thus has a clear view of the anterior surface of the stricture. A probe-pointed director is then passed through the stricture into the bladder and all the intervening stricture-tissue divided. After this has been done a catheter should be passed down to the urethral wound, and then guided into the bladder either with a finger in the wound or with a probe-pointed gorget. The catheter is then tied in and allowed to remain for two or three days.

My conclusions as to the treatment of organic strictures of the urethra may be summed up as follows:[1]

[1] *Morrow's System*, vol. i.

1. Strictures of large calibre (that is, more than 15 French) situated at or behind the bulbo-membranous portion of the urethra are to be treated, almost without exception, by gradual dilatation.

2. Strictures of large calibre in the pendulous urethra are likewise to be treated by gradual dilatation when very recent and soft, but by internal urethrotomy when of long standing, distinctly fibrous in character, or non-dilatable. It is to be remembered that the great majority of so-called strictures of large calibre of the pendulous urethra are merely instances of physiological narrowing.

3. Strictures of the meatus and in the neighborhood of the fossa navicularis should be divided on the floor of the urethra whenever it is evident that they are real pathological conditions producing definite symptoms, and are not mere normal constrictions.

4. Strictures of small calibre (less than 15 French) situated in advance of the bulbo-membranous junction, unless seen very early and found to be unusually soft and dilatable, furnish the typical condition for internal urethrotomy, which should be done with a dilating urethrotome, and invariably under strict antiseptic precautions.

5. Strictures of small calibre at or beyond the bulbo-membranous junction should be treated by gradual dilatation. But in cases of recent, irritable, or traumatic strictures in this region, or of strictures which for any reason (as the occurrence of rigors) are non-dilatable, external perineal urethrotomy is the operation to be preferred.

6. Strictures of the deep urethra permeable only to filiform bougies should be treated by gradual dilatation if possible, the bougie being left *in situ* for some time and followed by the introduction of others or used as a guide for a tunnelled catheter. If the stricture is not suitable for dilatation, external perineal urethrotomy should be performed.

7. Impassable strictures of the deep urethra always require the performance of perineal section.

Urethral Calculus.—It is somewhat rare that calculi originate in the urethra unless in the recesses of a dilated gland or of a sacculation or in a false passage; in the majority of cases the calculus forms in the bladder or kidney, and, after finding its way to the urethra, becomes impacted there, and makes its presence known at once by marked obstruction to the flow of urine. If there be stricture of the urethra at any point the calculus will lodge in the dilatation behind the constriction, and if it be small may cause only slight additional irritation and occasional stoppage of the urine, or it may occasion complete occlusion of the canal, followed by ulceration and finally perforation of the walls of the urethra and extravasation of urine. In the absence of stricture the calculus will often lodge behind one of the points of normal narrowing of the urethra, which, according to the recent experiments of Delpet,[1] are in the penile urethra at a point about one to three inches from the meatus and in the vicinity of the prepubic angle. A point of normal narrowing is situated also at the subpubic curvature where the urethra passes through the posterior layer of the triangular ligament. Calculi may also lodge in the prostatic sinus and in the fossa navicularis.

[1] *Ann. des Mal. des Org. gén.-urin.*, Mar., 1892.

Occasionally urethral calculi are multiple and associated with vesical concretions; Cunningham reports[1] a case where he extracted twelve fragments of calculi from a urethra, and then performed lateral lithotomy and removed twenty-three pieces from the bladder. The largest urethral fragment removed per urethram measured half an inch in length, three-eighths of an inch in width, and a quarter of an inch in thickness; completely dried, it weighed 8 gr.

Symptoms.—When the calculus does not completely block the urethra symptoms may be felt for a long time before the patient seeks relief in an operation; if the calculus lodges in the anterior urethra and does not shut off the flow of the urine, the pain will probably be very slight and the frequency of urination perfectly normal. When the calculus becomes fixed in the prostatic or the membranous urethra, the vesical tenesmus and the hemorrhage caused by the forcible closure of the canal on the sharp edges which these concretions (being fragments of larger vesical calculi) usually have, will simulate very closely the symptoms of vesical calculus. If the urethra be completely blocked, the symptoms at once become most serious, and unless the obstruction is removed without delay there is grave danger of rupture of the urethra, extravasation of urine, and gangrene and sloughing of the parts. A case of calculus impacted in the urethra, causing gangrene and urethral rupture, is reported by Morton:[2] the patient had suffered from absolute retention for nine days before he came under observation. The penis and scrotum were enormously swollen and œdematous, and the skin over them was dark-colored and gangrenous in patches; the urethra was opened by an incision which divided the scrotum and liberated a large amount of extravasated urine and exposed the urethra in the perineum. The rupture was found to be in the penile urethra, just in front of the scrotal junction; the bladder was drained through the perineum and recovery was uneventful, except that a urethral fistula remained, which, however, it was proposed to close as soon as the repair of the damaged tissues had advanced sufficiently.

Treatment.—When the calculus has recently passed into the urethra and does not occlude the canal completely, it may be possible to dislodge it by getting the patient to make a forcible effort at urination after the parts have been relaxed by a hot bath and the administration of opium and belladonna. Or the urethra may be distended with an injection, which is then allowed to escape suddenly as the patient makes an effort to urinate; this may be repeated several times, and if the calculus be impacted in the anterior urethra, it may be possible to work it gradually forward by manipulations on the under surface of the penis. When these means fail it must be extracted with long urethral forceps, which are so made that the blades open only at the tip. When the calculus is lodged in the posterior urethra, and is apparently too large to be extracted through the anterior portion, it may be shoved back into the bladder, where it can be crushed and washed out in the ordinary manner. Often, however, the case is not presented for treatment until all urethral instrumentation is out of the question, owing to the swelling, inflammation, and possibly to gangrene and to extravasation of urine. In this case perineal section is unquestionably indicated. The bladder

[1] *Brit. Med. Journ.*, July 5, 1890.

[2] *Ann. of Surg.*, June, 1895.

should be drained and free incisions made over all the infiltrated areas to permit escape of the urine.

Foreign bodies other than calculi, introduced in the urethra either by accident or with intent, produce the same symptoms as do calculi and require the same operations for their removal.

Sterility and Impotence.

STERILITY.

Sterility in the male is that condition in which, if there be any seminal fluid at all, it lacks all fecundating power. The absence of this power may be dependent upon one of two conditions—namely, the semen may be ejaculated in normal amount, but the spermatozoa are either entirely absent or are dead when discharged; this constitutes the condition of azoöspermia; or there may be a total absence of all seminal fluid, constituting the condition known as aspermia. In both cases the act of copulation, which is merely the union of the male and female organs, may be complete.

Possibly, as a corollary of these two conditions, there might be reckoned malemission, which, though not characteristic of sterility, ends in the same result. In malemission the semen may be normal and may be discharged into the urethra, but it is not ejaculated into the vagina.

Normal semen when it is first ejaculated is gelatinous, opalescent, and has a characteristic odor—is alkaline in reaction and liquefies with time. Nine-tenths by bulk of the spermatic fluid when in the vas deferens is composed of spermatozoa, but during ejaculation it becomes mixed with the secretions of the seminal vesicles, the prostate, Cowper's glands, and the urethral crypts and follicles, and thereby the proportionate quantity of the spermatozoa is reduced in bulk to about one-half. The quantity ejaculated at one time is on average from one to two drachms.

Under the microscope the seminal fluid is seen to contain, in addition to the spermatozoa and spermatic cells, epithelium from the genito-urinary tract and molecular detritus. In normal fresh semen several million spermatozoa are discharged in one ejaculation. Each spermatozoön has an oval head and a long thread-like tail; just behind the head there is often a bulbous enlargement. The vitality of spermatozoa when they are kept in a warm fluid medium, slightly alkaline, is long preserved. According to Godard,[1] the tails may be seen actively vibrating for more than three days after ejaculation; in a healthy vagina they may live for eight days. It is stated that spermatozoa which die outside of the seminal tract have straight or slightly bent tails, while those which die in the seminal tract have tails spirally coiled or bent at an angle. This latter condition is observed when spermatozoa have been destroyed by contact with certain acid secretions of the vagina.

Azoöspermia may be due (1) to failure of the testicles in producing spermatozoa, or (2) to a mechanical obstruction in some part of the passage by which the spermatozoa ought to reach the urethra. The testicles fail to secrete spermatozoa when there is bilateral retention (cryptorchidism) or bilateral atrophy, or malignant, syphilitic, or tubercular degeneration of both glands; it is also obvious that no spermato-

[1] *Étude sur la Monorchidie et Cryptorchidie.*

zoa will be secreted when both testicles are absent either congenitally (anorchism) or from castration. Occlusion of any portion of the excretory ducts may be either congenital or acquired. Acquired obstruction or occlusion of the epididymis, vas, or ejaculatory ducts is the common cause; the most frequent cause of all is bilateral gonorrhœal epididymitis. Among the rarer causes of obstruction of either the epididymis or the vas should be mentioned wounds, syphilitic, tubercular, and malignant degeneration, and the pressure of tumors.

ASPERMIA is the condition in which either no seminal fluid is produced, or else it is entirely retained within the seminal vesicles and no ejaculation takes place. This latter condition occurs only when there is an occlusion of the common ejaculatory ducts, and would not be produced by an obstruction of the vasa deferentia. Finger instances chronic posterior urethritis as a cause of obliteration of the opening of the common ejaculatory ducts.[1] The occlusion may also be congenital or it may be the result of traumatism (chiefly that inflicted by the surgeon during the operation for stone). A very rare form of obstruction, mentioned by Reliquet,[2] is that produced by the lodgement of a concretion in the duct.

The forms of obstruction mentioned above produce, it is true, an apparent condition of aspermia, but in the strictest sense of the term it is not true aspermia, since seminal fluid is produced, but is retained in the seminal vesicles or in the ducts.

True aspermia is a much rarer condition, and may be due to anæsthesia of the glans penis, whereby there is no reflex excitation of the ejaculatory centre in the cord, or it may occur in cases of cryptorchidism or in anorchidism, although this is not the invariable rule; in the case of cryptorchids, where the testicles are functionless, the other parts of the sexual apparatus are either entirely wanting or are much atrophied. Occasionally anorchids, while incapable of procreation, nevertheless have sexual desire and occasional involuntary emissions,[3] and are quite able to copulate.

Malemission is where, although the testicles and accessory sexual glands secrete normal seminal fluid capable of fecundating, the fluid is not properly ejaculated into the vagina, but is retained in the male urethra, and exudes only drop by drop after coitus has been completed; or the power of ejaculation may be perfect, but owing to some fault in the urethra, such as hypospadias, epispadias, or urethral fistula, the semen escapes from the urethra before it reaches the vagina. The patient suffering from an affection such as this cannot be said to be sterile, neither is he impotent, yet the result is the same: he is incapable of procreation.

The **treatment** of sterility, when this is dependent on absence of any portion of the excretory apparatus or upon occlusion of the vas or ejaculatory ducts, is hopeless. When dependent upon gonorrhœal epididymitis, if of comparatively recent origin, active absorbent treatment, combined with pressure, may be of some service. When dependent upon stricture of the urethra, full dilatation of this canal is curative. If sterility is the result of muscular inco-ordination, tonic and stimulant

[1] *Blennorrhœa of the Sexual Organs*, p. 177.
[2] Quoted by Morrow, *System of Gen.-urin. Diseases.*
[3] Vide Casper's *Forensic Medicine*, New Syd. Soc. Pub., 1864, p. 256.

treatment directed to the general nervous condition may be beneficial. For chronic suppuration of the seminal vesicles, with consequent devitalization of the spermatozoa, massage of the vesicles, combined with appropriate treatment for the posterior urethritis, is indicated.

IMPOTENCE.

Impotence—or, for the sake of a better understanding of the condition, to give the term in full, *impotentia coëundi*—implies an inability on the part of the male organ of copulation to perform its proper function. In the generality of text-books counsel is so darkened with many words that from them it is impossible to arrive at any clear idea of the difference between impotence and sterility. In the strict sense of the full term impotence applies only to disorders affecting the function of the organ of copulation, while sterility applies only to lack of fertility in the reproductive elements produced by either sex, if produced at all.

Impotence may be due either to congenital or acquired deformity, or to deficient or entire lack of erection; hence it may be classified as *organic* or purely *functional*.

ORGANIC IMPOTENCE.—The congenital deformities which cause impotence are complete absence of the penis, lack of development of some portion of the organ, either of the corpora cavernosa or corpus spongiosum, or of the walls of the urethra (hypospadias or epispadias), or a rudimentary condition of the whole organ; associated with hypospadias there is usually a firm band of adhesions between the penis and scrotum which absolutely prevents erection and intromission. Among the acquired causes may be mentioned fibrous or cartilaginous indurations, the result of traumatism of the erectile tissue (which distort the penis), gummatous infiltration, aneurysmal dilatation of the corpora cavernosa, varix of the dorsal vein, and other tumors of the penis or its sheath which render intromission impossible. Occasionally the frænum is so short that during erection the glans is bent downward, and copulation is not only extremely painful, but often impossible. Certain conditions of the neighboring tissues cause impotence, although there is no organic disease of the penis itself; among such causes may be mentioned large scrotal or inguinal hernias, obesity, enormous hydroceles, elephantiasis of the scrotum, etc.

The treatment of organic impotence, when due to congenital deformity, is, in the majority of cases, of little avail; where it depends upon gummatous deposits, these will usually yield to specific treatment, combined with the resolvent effects of heat, moisture, and pressure secured by the application of a firm rubber bandage to the penis. The same treatment by pressure is also applicable to aneurysmal dilatation of the corpora cavernosa. Congenital adhesions of the penis to the scrotum and an abnormally short frænum may sometimes be remedied by a plastic operation, or in the latter case by simply cutting through the frænum. Where impotence is due to enlargement of the scrotum, the removal of the cause will restore the function of the penis, which has been merely in abeyance; in elephantiasis of the scrotum, even though the penis be completely imbedded in the enormous overgrowth of the tissues, the penis usually remains entirely unaffected by the disease,

which is true also of the testicles; when, therefore, the scrotal tumor is removed, the function of the penis will be restored.

FUNCTIONAL IMPOTENCE is of three varieties—namely, (*a*) Psychical; (*b*) Irritative; and (*c*) Atonic.

(*a*) *Psychical Impotence.*—This form has been also termed false or imaginary impotence; it is in reality a disease more of the mind than of the sexual organs. The patient seems perfectly capable of copulation, but apprehension of failure overcomes all capability and the erection subsides, or, instead of enlarging, the penis may shrink.

As to the cause of this condition, when once we enter the realm of psychology these causes may be as various as the temperaments of man, and it is impossible to enumerate the subtile influences which may affect the mind of the patient.

The **diagnosis** of this form of impotence can be made only after a most thorough examination which eliminates all possibility that the disease depends upon a degeneration of the spinal centres or of the nerves which govern the sexual organs. Absolute continence should be enjoined upon the patient for some time, and, when possible, exercise in the open air, cold bathing, and, in fact, everything that will tend to induce a *mens sana in corpore sano.* As much for the impression produced upon the mind as for anything else, a general tonic, such as the compound syrup of the hypophosphites, wine of coca and celery, or phosphoric acid and gentian, should be prescribed.

The **treatment** of cases of this nature requires great tact and insight on the part of the physician, and every effort must be made to inspire the patient with the belief that there is, in his case, no organic deficiency.

(*b*) *Irritative impotence* depends upon a hypersensitive condition of the prostatic urethra or of the glans penis the result of sexual excesses or possibly chronic urethritis. In this form of impotence erection may be complete and sexual desire strong, but owing to the hyperæsthesia of the part the stimulus to the spinal centres is always exaggerated and ejaculation is premature. The pain produced by the catarrhal condition of the prostatic urethra is constantly referred to the inner surface of the thighs, to the hips, the anus, the hypogastric region, or to the small of the back. All the general and local symptoms observed in hysterical women the subjects of chronic inflammation of the uterus are duplicated in men suffering from catarrh of the prostatic urethra; thus these patients usually suffer from headache, mental fatigue, backache, extreme agitation from slight causes, a tendency to clammy sweats, palpitation, dyspepsia, and constipation. Frequent nocturnal emissions, prostatorrhœa, and irritability of the neck of the bladder are also common and annoying symptoms.

The constant excitation of the spinal centres eventually produces exhaustion, and the irritative form of impotence gradually merges into the atonic form.

The urine is often abundant, of low specific gravity, and passed frequently; occasionally it contains spermatozoa, and there is nearly always some prostatic fluid discharged at the close of urination or during defecation. In the early stage, when the posterior urethra is acutely involved, priapism is not infrequent, and the secretory neuroses are manifest in the ejaculation of an abnormally large amount of semen—*polyspermia;* a

total lack of semen—*aspermia;* or a hypersecretion from the prostate, the seminal vesicles, the glands of Cowper, and the urethral crypts and follicles—*prostatorrhœa.*

Examination of the urethra with bulbous bougies will usually make evident several abnormally tender points in the deep urethra, and several drops of seminal fluid can be pressed out of the seminal vesicles by massage through the rectum; after this massage the urine will be found to contain numerous spermatozoa, usually in active motion.

The **prognosis** is almost always favorable, even when erection is entirely lacking during efforts at intercourse but fairly strong at other times, especially if an inflammation of the prostatic urethra is found sufficiently severe and chronic to account for the symptoms, or if a redundant prepuce is the cause of the constant irritation of the glans.

The **treatment** must be both general and local; all pathological conditions of the neighboring organs or tissues which may produce reflex irritation of the genital organs must be remedied, and the urine should be rendered bland by means of internal remedies and proper diet.

The *local treatment* consists in the dilatation of strictures, the curing of granular patches or of hyperæmic inflammatory conditions of the urethra by applications, irrigations, and instillations, and the passage of full-sized cold-steel sounds or the use of the psychrophore. The sound should be of full normal calibre, should be introduced every third day, and should be allowed to remain in for fifteen minutes. When there are distinct evidences of suppuration in the posterior urethra, the sound should be preceded by irrigation carried back to the bladder either by means of a short nozzle and gravity-bag or by a soft catheter. The solutions that should be used for irrigation are silver nitrate, 1 : 6000; potassium permanganate, 1 : 6000 to 1 : 3000; bichloride of mercury, 1 : 20,000 to 1 : 10,000. After the sound, instillation should be practised, the most serviceable application being nitrate of silver, beginning with ten drops of a 1 per cent. solution and increasing the strength to a 5 per cent. solution, the same quantity being injected each time. Ulcerating spots in the anterior urethra which persistently discharge in spite of irrigation and sounding should be touched with a 10 per cent. solution of nitrate of silver through an endoscopic tube. In certain cases prostatic hyperæsthesia is best treated by heat or cold, applied by means of the psychrophore, which is a blind catheter with a chamber in its curved end which can be kept constantly at a given temperature by allowing water to circulate through it. The degree of temperature depends somewhat upon the sensations of the patient; highly irritable cases usually do best under the application of cold.

Heat and cold may be also applied through the rectum by means of a rubber bag distended with water at the proper temperature, or by a two-way rectal injection-pipe, by means of which a stream of water is thrown against the prostate and base of the bladder and escapes without distending the rectum.

(*c*) *Atonic impotence* is usually the consequence of a long duration of the irritative form: the spinal centres become thoroughly exhausted by constant excitation, and finally no stimulation whatever is conveyed to the muscles and nerves controlling erection and ejaculation. Exceptionally the excitability of the genito-urinary spinal centre is lessened from

causes other than posterior urethritis; a general depressed condition of the system—such, for instance, as occurs in anæmia or in any of the cachexias, diabetes, rheumatism, uræmia, and cholæmia—may occasion this result. Certain agents, among which may be mentioned lead, carbonic-acid gas, bisulphide of carbon, and particularly alcohol and tobacco, may also cause complete impotence when taken in poisonous doses, and many drugs even in physiological doses will produce temporary impotence; chief among these are the bromides.

In this form of the disease erection is either completely wanting or very feeble, ejaculation produces scarcely any sensation, and occasionally the anæsthesia of the parts is so profound that even the application of the electric brush produces no pain. The local motor-neuroses may appear in the form of dribbling of urine after micturition or sudden stoppage of the stream or paralysis of the bladder or its sphincters; when ejaculation, or what passes for it, does take place, the semen is not expelled from the urethra at once, but exudes drop by drop some time after.

The possibility of curing this form of the disease is small when the degeneration of the spinal centre has once begun.

The **treatment** must be directed mainly toward improving the general tone of the nervous system and stimulating the exhausted lumbar centres. For this purpose the alternate cold and hot needle-spray, wet packs, sitz-baths, and particularly electricity, will be found quite beneficial. The internal administration of strychnia, arsenic, iron, damiana, or phosphorus is decidedly indicated.

PROSTATORRHŒA.—The discharge of prostatic fluid, which depends simply upon a catarrhal condition of the posterior urethra, is a symptom of such prominence in many cases of impotence that it is worthy of brief separate consideration. The hypersecretion does not flow steadily from the meatus, but only appears when it is pressed out by the muscular contraction incident to defecation or to the final efforts of urination. The discharge resembles semen, and microscopic examination nearly always shows some spermatozoa. It produces a profound impression upon the patient's mind, since he believes he is suffering from true spermatorrhœa. The general symptoms are those already described as characterizing the irritative form of impotence, and the **treatment** is practically the same, excepting for the fact that certain medicines usually have a direct and almost specific action. Among the most useful of these are oil of sandal-wood, cubebs, copaiba, belladonna, atropine, and hyoscine. Ergotine is sometimes of service, apparently by causing tonic contractions of the muscular fibres of the prostate, and bromide of potassium will assist greatly in allaying the general nervous erethism. Occasionally the prostatic dilator is decidedly beneficial, probably because it mechanically empties the diseased follicles and allows local applications to gain access to every part of the mucous membrane. Counter-irritation to the perineum in the form of fly blisters is sometimes followed by improvement.

INVOLUNTARY SEMINAL EMISSIONS are properly classed as symptoms of impotence, and may appear in the form of nocturnal pollutions, usually attended with vigorous erections and voluptuous sensations; or of diurnal pollutions, the result of peripheral irritation too feeble to

excite emissions in a healthy man, and which are attended with weak or quickly-subsiding erections and blunted sensations; or these emissions may take the form of an almost constant oozing of semen from the meatus without erection and without sensation—the condition known as *true spermatorrhœa*. This escape of semen is usually more profuse just after micturition and during defecation.

Nocturnal emissions are, to a certain extent, normal, and are indications of sexual weakness only when they are unduly frequent or are followed by lassitude and mental depression, and particularly when they are associated with some form of impotence. It is perhaps correct to say that when emissions occur persistently three or four times a week in patients who are not subject to sexual excitement, there is a highly sensitive condition of the ejaculatory centre brought about reflexly or dependent upon systemic causes, and that if this erethism be not corrected there will ultimately develop impotence in some form. Diurnal pollutions and spermatorrhœa constitute by far the most serious form of involuntary emissions.

Treatment.—Nocturnal pollutions, if not more frequent than once a week, may require no treatment other than ordering a cold sponge-bath at night, preceded by light exercise; sleeping on a hard bed with a knotted towel so tied around the waist that dorsal decubitus is prevented by the pressure of the knot on the small of the back; discarding all superfluous covering; and rising once during the night to empty the bladder. When, in spite of these directions, the emissions continue, or even become more frequent, the patient should establish the habit of emptying the bladder before retiring, and should be given bromide of potassium, commencing with fifteen grains at bedtime and increasing the dose till the desired effect is obtained. In many of these cases hyoscine given at six o'clock, and again at bedtime, in doses of $\frac{1}{200}$ gr., acts as a specific. Atropine and belladonna are also serviceable; camphor, lupulin, and ergot are of less value. When the emissions are not controlled by these remedies, the direct urethral treatment appropriate to impotence is indicated.

SYPHILIS.

By R. W. TAYLOR, M. D.

By the term "syphilis" we understand a chronic infectious disease which begins in a local lesion, which lesion is caused by some morbid secretion or virus derived from a previously syphilitic person. Beginning thus as a local infection, it promptly invades the whole organism, more especially its connective tissue, induces inflammatory processes of a low grade, and gives rise to a low form of cell-growth called granulation tissue, and in late periods to connective-tissue increase in the nervous tissue. It is therefore a chronic granulation-tissue disease of protracted and irregular course, which in some respects resembles leprosy and tuberculosis, but which in many points differs from them and pursues a course peculiar to itself. In its early stages it presents points of resemblance in its evolution and course to the exanthemata and to diphtheria, but here, again, there are absent many features necessary to make the likeness complete. Syphilis is really a disease of such protean aspects that in some of its very numerous phases it presents points of resemblance more or less strong to almost every other morbid condition or disease. Indeed, the metamorphoses of syphilis are infinite. Reasoning analogically, with the features and pathological nature of leprosy, tuberculosis, the exanthemata, and diphtheria in mind, one is forcibly impressed with the view that syphilis is also a disease of microbic origin; but, striking as is the probability, the facts in our possession do not warrant us to go as far as some writers do who unhesitatingly call syphilis a disease of bacterial origin. A number of observers have found in active and early syphilitic lesions certain micro-organisms which have been revealed by delicate staining methods, but their numbers have been small, their presence not absolutely constant, and, furthermore, no cultures have been made, and consequently inoculation-experiments have not been tried. Therefore, all that can be said to-day as to the microbic origin of syphilis is, that in all probability this disease has as its virulent agent or virus some micro-organism, but we do not know what it is.

In the light of our present knowledge we need not discuss the old-time question as to the unity or duality of syphilis, and there is no longer any need for the retention of these terms in medical literature. Syphilis is a disease *sui generis*, which stands out prominently in pathology as a distinct succession of correlated morbid processes which may resemble many other morbid processes, but which is essentially different from them all. There is to-day only a very feeble and waning contention that there is a specific chancroidal virus, and in all probability in a very short time this much-written-about ulcer will be definitely and for ever

relegated to the group of lesions of the mucous membranes and of the skin produced by pyogenic microbes. There is no etiological relation whatever between syphilis and chancroid. Syphilitic lesions and syphilitic integument and mucous membranes may be the seat of invasion of pus-microbes which produce in them lesions identical to the eye with the chancroid, but these are merely local accidents, not in any manner related etiologically to the syphilitic process. They are simply evidences of vulnerability of the tegumentary tissues of syphilis to invasion by pyogenic organisms.

There are two clearly-marked forms of syphilitic infection—the one called the acquired form, and the other the hereditary, incorrectly called the congenital form. In the acquired form the infection is derived from a person previously infected in whom the disease is active. In the majority of cases syphilis is contracted in the sexual act, and for this reason this disease is classed among the venereal diseases. It is then syphilis of genital origin. There are, however, many instances in which syphilis is not contracted in coitus; for example, from kissing a syphilitic, by inoculation in operations on, and examinations of, syphilitics, and from contamination from any article which by some means or accident may be smeared with the syphilitic virus. These latter forms are termed cases of extra-genital syphilis, and from the fact that in most instances there is no moral transgression or erotic origin in their causation they are classed under the category *syphilis insontium*, or "syphilis of the innocents."

Hereditary syphilis is that form in which infection is derived from one or both parents at the time of conception. It is very doubtful whether true syphilis can be transmitted to the child during gestation. For purposes of clinical description and for various therapeutic considerations it is well to preserve Ricord's division of the disease into three periods—the primary, the secondary, and the tertiary. Though this division is oftentimes chronologically incorrect, and though anatomically there are many exceptions to it, it is the best we have, and it can be put to a good purpose when its shortcomings are known. Ricord's division assumes a uniform, methodical, and progressive course and development of the disease, which may be observed in some cases, but is wanting in others. In the primary period the disease is nearly always quite regular in its course and chronology, and tolerably clear lines may be laid down concerning it. In many cases the secondary period is quite regular and the morbid processes develop superficially and in mild form. Then in due time (the disease for any reason being progressive) tertiary symptoms show themselves, and we have an orderly and tolerably systematic evolution of syphilis from the primary, through the secondary, to the tertiary stage. But in many cases there is a want of uniformity of evolution, for lesions of a tertiary character appear precociously; they may coexist with secondary lesions, and not infrequently after the precocious appearance of tertiary lesions, those of the secondary period show themselves. While, therefore, it is often impossible to draw sharp lines of difference between a secondary and a tertiary stage we can hold fast in most cases to the following course in our clinical studies and in regulating our therapeutics: namely, to consider superficial lesions of the skin and mucous membrane and various systemi

symptoms and conditions known to be of early development as evidences of the secondary period and claiming an appropriate treatment, and to look upon deep-seated lesions of the connective tissues and those of bones and viscera as belonging to the tertiary period, and requiring treatment for advanced stages.

Acquired syphilis is never developed spontaneously: its virus enters the organism at the point of infection, and always begins with the development of a local lesion, called the chancre, the hard or Hunterian chancre, the infecting chancre, the initial sclerosis, the initial lesion, the primitive neoplasm, or the primary lesion. No attention whatever should be paid to cases called *syphilis d'emblée*, in which it is claimed that syphilis began without initial lesion. As Ricord graphically remarks: "Syphilis never invades the organism without causing its gap (*trou*): it always has a port of entry. This gap, this port of entry, is the accident of contagion (initial lesion), which is the prelude of all the others, while it is always separated from them by an interval more or less long, and which is the indispensable exordium of the disease."

Syphilis, therefore, is communicated to the healthy person by means of the secretions of a person suffering from that disease, and the first evidence of the infection is shown in the initial lesion. Mankind alone seems susceptible to the action of the syphilitic virus, since experiments upon animals have clearly shown that they are immune to it.

VEHICLES OF THE SYPHILITIC VIRUS.—Clinical observations and experimental inoculations have proved beyond a doubt that the secretion of the initial lesion contains in a high degree the virus of syphilis. It is from the secretion of the initial lesion that the infection with the disease is derived in the great majority of cases.

Equally as virulent is the secretion of the secondary lesions known as condylomata lata and mucous patches which occur so frequently in and about the mouth and face and on the genital and anal regions. Numerous experimental inoculations have been made with these secretions, the result of which proves beyond any doubt their infectious quality. By some observers it is held that these secretions are the most common source of syphilitic infection. They in all probability rank next in point of frequency of infection to that of the initial lesion.

Experimental inoculations (of course upon human subjects, since animals are immune) have proved beyond all doubt that the secretions from syphilitic acne-pustules, from a syphilitic tubercle, and from syphilitic ulcers and papules produce typical syphilitic infection in the person operated upon. Numerous experimental inoculations with the blood of syphilitics have given rise to well-marked instances of syphilitic infection. Clinical observation has frequently confirmed the results of experimentation as to the infectious quality of the blood of syphilitic subjects.

The vehicles of syphilitic infection are therefore as follows: First, the secretion of the initial lesion; second, the secretion of mucous patches and condylomata lata; third, the secretions of secondary pustules, tubercles, and papules; fourth, the blood of syphilitics; and, fifth, the secretions and blood in active hereditary syphilis.

It is conceded by most authorities that while the secretions of the

secondary lesions are infectious, those of the tertiary period are inert. Unfortunately, we are not in possession of enough knowledge upon the subject to make positive statements. It is very certain that when the disease is active, as shown by the extent and severity of the lesions, the secretions of its subject are markedly infectious. As time passes, the morbid condition tends in most cases to attenuation, and the infectious nature of the secretion grows less. There is a natural tendency in very many cases for the disease to grow less and less active, until in the end its virulence may be lost. This gradual extinction of the disease may take place spontaneously, without the aid of therapeutics, but this natural involution can never be relied upon. The most potent element in curing the disease—and by thus doing rendering the subject incapable of infecting others by any means—is active and energetic treatment kept up for the first two years or longer. Under proper treatment the infectiousness of the disease more or less rapidly diminishes, and finally becomes extinct. My studies and observations have convinced me that in the majority of cases in which the treatment has been ample and well directed a cure is obtained in two or three years, and then of course the subject does not give forth infectious secretions. It is very probable that the secretions and tissue-elements of many of the tertiary lesions, particularly when they are active and numerous, are endowed with a virulent power; as they grow older and less numerous they may lose their virulence. We are sadly in want of exact knowledge on this important subject. The normal secretions of a syphilitic subject do not of themselves contain any virulent principle. They may be contaminated by admixture of secondary secretions and by blood. The saliva is perfectly harmless if the patient's mouth is free from syphilitic lesions. This has been clearly proved by the experiments of Diday and Profeta. When mucous patches, condylomata lata, buccal, tonsillar, and pharyngeal hyperplasiæ, excoriations, and fissures exist in the mouth, the saliva is contaminated by their secretions and is then potently infectious.

The sweat does not contain any virulent principle.

The experiments of Vidal have shown that the tears are innocuous. Any secreting syphilitic lesion of the eyes, such as chancre or mucous patches of the conjunctiva and secondary hyperplasia of the caruncles, may of course contaminate this fluid.

The semen of a man even in the secondary stage of syphilis is not *per se* an infectious fluid. It may remain on the mucous membrane of the female genitals without causing any bad results. It does not contain an active virulent principle. This was well shown by a number of well-performed experiments by Mireur, who produced excoriations upon healthy subjects by instruments and by blistering, and placed upon them the semen of a man suffering severely from secondary syphilis. In his four experiments failure to inoculate resulted.

When the semen of a man suffering from an active form of syphilis fecundates the female ovum, in the majority of cases he transmits the disease to the infant. In this way alone is the semen of the syphilitic man dangerous.

There are a number of cases reported in literature in which it is claimed that women were directly infected by the semen of syphilitic men, the more notable ones being those of Smith and Jordan. Years

ago I submitted all the cases of this so-called method of infection to a rigid and impartial examination and analysis, and the conclusion reached was that the infection was due to blood exuding in the sexual act from the penis upon some abrasion or fissure of the female genitals.

The milk of the syphilitic woman does not possess infectious qualities. Padova and Profeta made inoculations and injections upon healthy persons with the secretion derived from an infected woman, and were rewarded with negative results. In like manner the sweat has been shown to be innocuous upon experimental inoculation.

MODES OF INFECTION.—These are, first, direct contact; second, mediate infection; and, third, hereditary transmission. We are warranted in assuming that in all instances of syphilitic infection there is a lesion of continuity or gap in the epithelium of the skin or mucosa. Infection by direct contact is the most common mode of contamination, and the sexual act is the one by which the disease is in most cases given and received. Direct syphilitic infection frequently occurs in unnatural and beastly methods of indulgence between persons of the same or of the opposite sex. In this way are developed chancres of the anus, of the tongue, of the folds between the breast and the sides of the chest, of the axillæ, and of the tonsils. I have known several instances in which men were infected upon the penis by contact *ab ore* with men or women who had syphilitic lesions in their mouths. Several men have told me that they followed this practice, thinking that by it they would escape syphilitic infection.

Kissing also is a prolific source of infection, and by this act chancres on various parts of the body are produced.

Not infrequently hereditary syphilitic children infect their nurses upon the nipple from mucous patches in their mouths. Then, again, children have been infected from chancres or condylomata lata on the nipples of their nurses.

I have a number of times seen chancres of the nipple in women produced by suction by a man having mucous patches in his mouth. Then, again, I have seen two instances of chancre of the nipple in men derived from the mouth of syphilitic women in the act of suction.

There are in literature many cases reported in which syphilitic midwives, usually of the lower classes, have infected nursing women with syphilis upon the nipple in the act of suction or drawing the breast which they sometimes perform.

In some European countries, particularly Roumania, a singular mode of transmission is said to occur. It is the custom there to attribute all affections of the eyes to foreign bodies, for the relief of which there is a class of women called "leeching oculists" who suck or cleanse the eyelids with their tongues. One of these women, having mucous patches in her mouth, conveyed the disease to many persons.

Syphilitic infection is sometimes produced during brawls and fights in which an infected person bites his or her antagonist. In this way also in exuberant embraces between the sexes one or the other sometimes becomes syphilitic. I recall vividly the case of a lady who had a hard chancre under her chin who was playfully bitten by a syphilitic lover, and that of a gentleman having a chancre of the neck who was bitten in an amorous encounter with a *puella publica*.

Surgeons may contract syphilis in cuts about the fingers and hands when operating upon syphilitic subjects. Physicians, accoucheurs, and midwives also occasionally contract syphilis in digital examinations of infected women. They in turn have been known to spread syphilis far and wide in an epidemic form by infecting women during examinations about the genitals by means of their finger-chancre. From the infected wives the husbands, children, and friends have become contaminated.

There are many cases in literature in which syphilis has been communicated in the operation of tattooing, the operator having used his own saliva, which was contaminated by the secretions from mucous patches.

In the operation of skin-grafting the disease has been given to the person operated upon by the graft, which was derived from a syphilitic subject.

Dentists sometimes contract syphilis from the mouths of infected clients, and it is probable that the latter are sometimes infected by means of instruments smeared with active syphilitic secretions.

In ritual circumcision, where the flow of blood is staunched by immersion of the infant's penis in the mouth of the operator, there is danger of syphilitic infection.

In these days, when pure bovine virus is used in vaccination, there is no possibility of the transmission of syphilis by that secretion. The danger arises in carelessness on the part of the operator in using a soiled scarificator. In the hurry incident to the vaccination of many persons the surgeon is liable to become careless and to fail to cleanse his instrument after each operation. In this way it may happen that a syphilitic person may be vaccinated, and the instrument used may become smeared with blood and tissue-débris. Then, if this instrument is used to scarify the next subject without having been cleansed or subjected to a flame, this blood and these tissue-elements are firmly implanted upon and into his or her excoriated surface, and it is pretty certain that syphilitic infection will be produced. I saw a striking instance of this form of transmission of syphilis many years ago, when most of the inmates of the penitentiary were vaccinated. The victim was a baby, the offspring of a convict mother, and the source of the infection was a female prostitute, suffering from active secondary syphilis, who was vaccinated immediately before the infant. The golden rule of action under these circumstances is to have an alcohol flame at hand, and to submit the scarificator to it after each operation. A longer time will of course be required, but there will be no fear of syphilitic infection.

Mediate Infection.—In this form of infection the disease is communicated by means of articles, implements, or instruments which have become smeared or impregnated with the syphilitic virus. In the cases of this form of infection the contaminated parts are most commonly the mouth, the lips, the gums, and the eyelids. Any part of the integument and of the genitals may also be the seat of infection. The following list includes most of the articles and instruments which have been found to be the agents of mediate syphilitic infection: cigars, cigar- and cigarette-holders, pipes, tooth-brushes, tooth-powders, drinking utensils, knives, forks, spoons, razors, towels, sponges, pillows, masks, gloves,

wash-rags, linen thread, silk thread, pins, needles, children's toys, nursing-bottles, rubber tubes, babies' rubber rings, trousers, women's drawers, bandages, surgical and cupping instruments, manicure instruments, syringes, scarifiers, dental instruments and appliances, caustic-holders, blow-pipes, paper-cutters, lead pencils, speaking-trumpets, musical instruments, fish-horns, whistles, the mouth-piece of the telephone, chewing gum, and even pastilles and candy.

There is a mode of syphilitic infection which has not yet been described: it is really auto-infection. It generally occurs in this way: A man, fearing to contract venereal disease or for other reasons, contents himself with a digital exploration or fondling of the female genitals. Upon the latter, condylomata lata or syphilitic excoriations being present, the fingers of the man become soiled with their secretion. Then by accident the virus is transferred by the finger or fingers of the man to some other part of his own body, generally by scratching or picking. In this mode the finger becomes the medium of infection, and the infected parts are usually the alæ nasi, the tip of the nose, the chin, the cheek, the neck, the arm, and the back of the hand.

It is rather revolting to one's feelings to put the matter on paper, but the interests of medical science certainly warrant the recital. I have seen two cases in educated and religious people in which the weight of evidence strongly pointed to the origin of their labial chancres in the communion-cup. Knowing as we do so well that many innocent persons, particularly women, become unconscious victims of syphilitic infection, and still follow the observances of a religious life, it is not far-fetched to assume that their diseased mouths may contaminate the sacred chalice.

It may be positively stated that almost all of the human race are susceptible to the syphilitic poison. In some subjects this disease seems to take a light hold, and its course is mild and short; in others it is more severe; while in a small number of cases it assumes a malignant form, the tissues of such patients seeming to be profoundly influenced by the infection. It has been claimed that hereditary syphilis confers on its bearer an immunity to the acquired disease. In some cases this may be the case; in others perhaps only a partial immunity is conferred, which renders the course of the acquired disease lighter and shorter. There can be no doubt, however, that in some cases there is no immunity. I have seen an adult who suffered from hereditary syphilis in early life who became infected with the acquired form about puberty.

One attack of syphilis usually confers on its sufferer immunity against subseqent infections. This occurs so frequently that it was claimed by Fournier and others to be absolute. Such, however, is not the fact. There is a number of well-substantiated cases in literature in which there is distinct evidence of the occurrence of a second attack of syphilis. This proves very clearly that the effects of the first attack must have become extinct. Reinfection with syphilis, however, is far less frequent than it has been claimed to be. Out of the one hundred and forty-odd cases reported in literature as instances of second infection with syphilis, fully one hundred should be thrown aside as utterly worthless and apocryphal. It is always well to look critically and with great sus-

picion upon any case in which a shorter interval than four years has existed between the two claimed infections.

Some women who are healthy may carry a child the offspring of a syphilitic father, and through it not become syphilitic, but may gain a greater or less immunity to a subsequent infection.

The mode of development of syphilis in its primary period is peculiarly orderly and slow, and unattended with any striking features. After the infecting coitus or contamination of the subject nothing is usually to be seen of the impending infection for some time. It sometimes happens that pus-infection occurs synchronously with the syphilitic infection. In such a case a chancroid appears in a day or two, and it may continue to exist up to the time of the appearance of the syphilitic chancre, or it may be cured before that event. In somewhat rare cases herpetic vesicles appear just after coitus upon the spot on which later on the chancre appears later. In like manner, traumatisms, such as fissures and excoriations, may show themselves quite promptly, but these are only accidents.

The disease always begins at the infected part, which is commonly the genital organs. In somewhat rare cases two parts of the body may be infected at the same time. Thus we find the initial lesion of the penis not very infrequently coexistent with a similar lesion on the lip or the face or the finger or other parts of the body. These cases are classed under the head of *chancre à distance*.

It must be remembered that there is no haphazard about the development of syphilis. Wherever the poison has been implanted, there the initial lesion develops. As Ricord so brightly and happily says: "In the case of syphilis the person is first punished where he has sinned. If the penis, and it alone, has been exposed, it is on the penis that he is hit. If the exposure has been by the mouth or the anus, it is upon the mouth or the anus that the first accident (initial lesion) manifests itself. Look at the case of nurses: they are exposed at the breast, and it is there that they are first affected."

In a large majority of cases there is but one chancre or initial lesion, but it is not at all uncommon to see two or three, and exceptionally four, six, seven, and even more, initial lesions. There is a deep-rooted and widely prevalent view in the minds of many medical men that the initial lesion is invariably solitary, and that when several are seen they must be chancroids. This opinion is a relic of the old-time, narrow-gauge differential diagnosis between the chancre and the chancroid. Dualists harped upon the solitary chancre and the multiple chancroid. It must be remembered that a multiplicity of lesions is only mildly presumptive of their being chancroids; there is a chance that they may be hard chancres; consequently their examination should be very carefully and thoroughly made. The penis, the female genitals and breasts, and the fingers are the parts upon which multiple initial lesions are most commonly found.

The time which elapses between the infecting coitus or contamination and the appearance of the initial lesion is called the *first* period of incubation. This is never less than ten days, and cases of such short incubation are the very greatest of rarities. As a broad general statement it may be said that in most cases the first period of incubation of syphilis

occupies fifteen days. The average of cases of experimental inoculation with syphilis showed a period of twenty-five days. These experiments were mostly made on the exposed skin, where the circulation is less active than it is about the mucous membranes of the genitals, so that I am disposed to think that in clinical practice the average of the first period of incubation is about twenty days. But it may be longer than that. Undoubted cases have been observed in which the period of incubation has been between twenty and thirty and between thirty and forty days. Incubation-periods longer than thirty or forty days are great rarities, though I have seen two undoubted cases in which it was sixty days, and others have had a like experience. Fournier speaks of a case of seventy-five days' incubation. It is well to be very skeptical in cases of seemingly long incubation. The memory of some patients is not good, while others have a personal reason for leading the surgeon astray.

The practical application of the fact of there being a primary period of incubation in syphilis is this: Whenever a man consults a surgeon as to the possible outcome of a suspected or suspicious coitus, he must be told that at any time between the fifteenth and sixteenth or seventeenth days the chancre may appear, and that he must be constantly on the watch for it for his own benefit in promptly seeking treatment and for the protection of women with whom he may have intercourse. In the vast majority of cases it is not necessary to prolong a man's anxiety, and even agony, beyond thirty days.

At the end of the *first period of incubation* the first evidence of syphilitic infection shows itself in the form of a small and usually innocent-looking lesion, which, as we have seen, is called the initial lesion, the Hunterian chancre, and the hard chancre. In the great majority of cases the initial lesion is seated on the sexual organs, and it is then termed genital chancre, while those found elsewhere on the body are called extra-genital chancres.

In the male, chancres are found most frequently on the prepuce, particularly near and in the sulcus coronarius, on the prepuce and glans near the frænum, on the lips of the meatus, one or both, and within it, and in the urethral canal, upon the glans, upon the skin of the penis, and at the peno-scrotal angle. They are sometimes found upon the scrotum and on such extra-genital regions as the lips, tongue, tonsils, on the nose (tip and alæ), on the eyelids, face, scalp, ears, neck, body, particularly near the pubes, breast and nipples, anus, buttocks, fingers, hands, forearms, legs, and feet.

In the female the initial lesions are found most commonly at the introitus vaginæ, on the labia majora and minora, in the vagina (quite infrequently), on the os uteri, at the fourchette, clitoris, meatus, and near the anus. Extra-genital chancres in women are not uncommonly found on the lips, tongue, tonsils, gums, hard palate, face, neck, upon the breast, either upon the areola or the nipple, upon the pubes and buttocks, and, in fact, anywhere upon the body.

The initial lesion consists of a localized mass or tumor of granulation-tissue. In its very earliest stages it consists of small round cells which are seated in coat-sleeve-like arrangement around the vessels. As the lesion grows older, some of these cells, which some think are emigrated white blood-corpuscles, develop quickly into elongated spindle-cells.

Besides these component parts—namely, infiltrated blood-vessels, small round cells, and spindle-cells—there are intermixed among them cells resulting from hyperplasia of the fixed connective tissue. These elements, therefore, constitute what we observe as the hard chancre.

Appearances of the Initial Lesion or Chancre.—It is very necessary that the diagnosis of the chancre should be made early, since a prompt recognition of its highly infectious nature may save other persons from contamination. In its early stages the chancre is such a seemingly trifling and innocent-looking lesion that its virulence is very apt to be overlooked.

There are six main conditions under which chancres appear at their very beginning. These are—first, the chancrous erosion; second, the silvery spot; third, the dry papule or patch; fourth, the umbilicated papule or nodule or follicular chancre; fifth, the purple necrotic nodule; and sixth, the ecthymatous chancre.

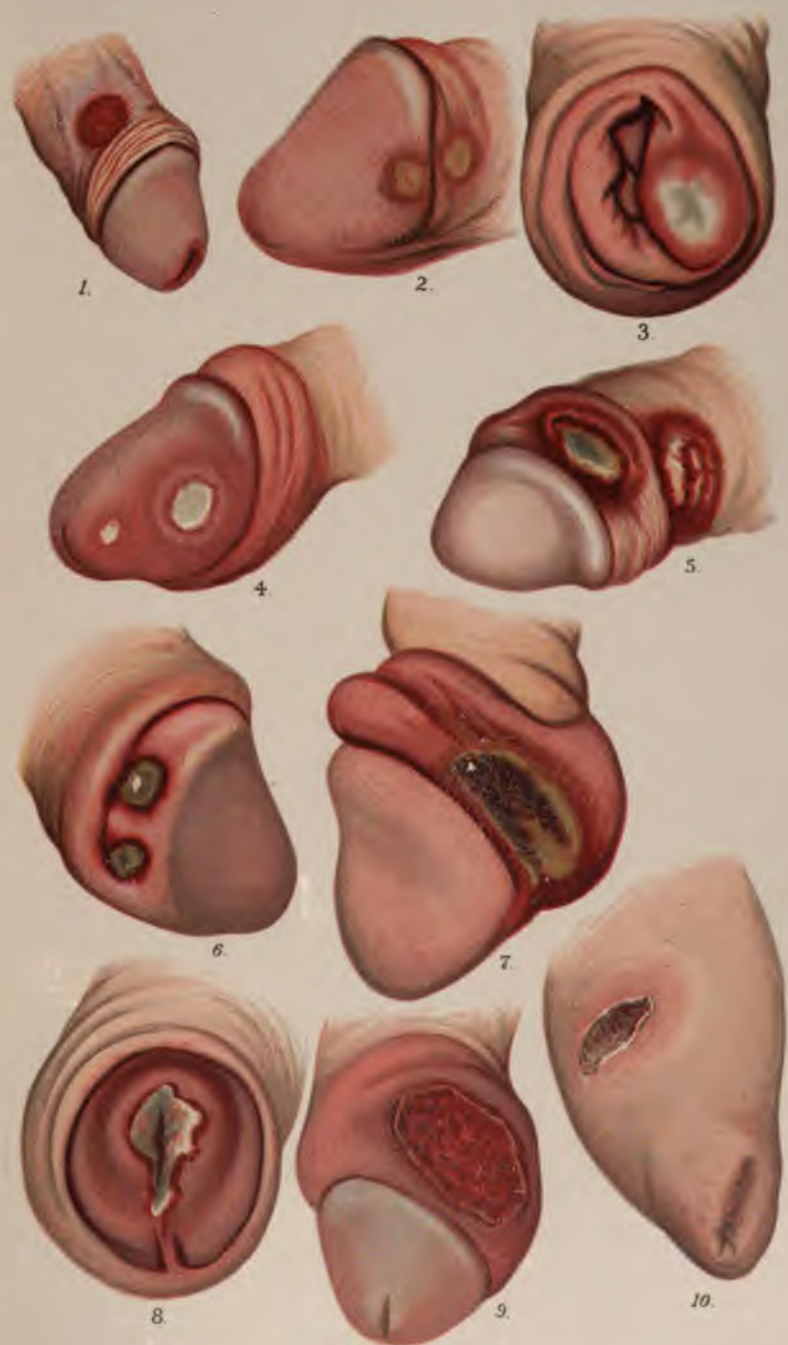
The chancrous erosion (see Plate VI. Fig. 1), by far the most common form, begins as a minute, sharply-rounded, excoriated spot, the surface of which is on a level with the surrounding parts. It looks exactly like an erosion or shedding of the uppermost epithelial layers. The color is of a dull red, which later on may assume a coppery hue. It has a smooth, polished surface, usually destitute of granulations, but sometimes slightly granular, from which considerable serous fluid oozes, particularly on manipulation. Usually there is but one such lesion, but there may be three, four, or five, and, very exceptionally, more than a dozen. When a number of these chancrous erosions are grouped together in a corymbous form, like the herpetic vesicles, they are called *multiple herpetiform chancres*, a variety first described by Dubuc. As they grow longer these herpetiform lesions usually fuse together and form a large chancrous erosion.

As the chancrous erosion grows older it becomes rather more salient, and sometimes its surface is a third or more of a line above the normal plane. It may also become complicated by induration in the connective tissue beneath it. When it simply remains a superficial lesion, the induration is spread out into a disk-like mass, and the lesion is then called "the parchment-like chancre." On the other hand, when the syphilitic process dips down into the subcutaneous connective tissue, the chancrous erosion becomes the indurated nodule. Parchment chancres are mostly found on the integument of the penis, and sometimes on the vulva. Indurated chancres are mostly found in the sulcus coronarius, particularly near the frænum. As the chancrous erosion grows old it may show a tendency to become more or less papillated, or even the seat of well-marked granulations.

In many cases these lesions become covered with a false membrane which is peculiar in having a color which is a mixture of a cream with a light-green tint. (See Plate VI. Figs. 3, 4, 5, and 7.) The membrane may exist for longer or shorter periods. As it grows old, if not shed it sometimes becomes in whole or in part of a brown or brownish-black color.

The silvery spot, first described by me, is very rare and presents well-marked features. It generally occurs on the glans and on the lips of the meatus, and at first as if a pinhead-sized spot of mucous mem-

PLATE VI.



Hard Chancres.

brane had been touched with carbolic acid or nitrate of silver. Examined with a magnifying-glass, there is no other change evident than the peculiar staining of the superficial epithelial cells. The silvery lesion increases slowly, but visibly, day by day, and preserves its integrity of surface until it reaches an area of about a line, when, coincidently with the subjacent induration, which has been simultaneously developing, and which has slowly raised it up into salience, it disappears, and is replaced by a smooth, shining surface like that of the chancrous erosion or of some indurated nodule.

The dry papule—papule sèche of Lancereaux—is usually found upon the glans or prepuce when they are not in coaptation, and consequently is always developed in a dry condition. As a rule, it is solitary; it is not uncommonly seen on persons who have been circumcised, and is found upon the integument of the penis, about the pubes, on the glans, and elsewhere upon the body. This form of the initial lesion begins as a dull-red spot, which increases in area as it grows to a height of from a half to one line and even half an inch. Its evolution is slow and aphlegmasic, and when fully developed it often resembles somewhat a not very scaly papule or patch of psoriasis, but is of denser consistence. Its surface is flat or slightly convex, its color a brownish-red, and it may or may not have a faint inflammatory areola. It may then run its course and subside gradually into a deeply-pigmented macule, or it may become exulcerous on its surface. From this exulcerous condition it not infrequently becomes encrusted, in which case there may be the creamy-green membrane or a thin brown or brownish-black crust over its surface. (See Plate VI. Figs. 3, 4, 5, and 7.)

A modification of this form of the initial lesion has been described as diphtheroid of the glans—a very incorrect term, since neither in appearance nor course does the lesion at all resemble diphtheritic membrane. It consists of patches of a glistening grayish-white color, presenting a sensation to the fingers something like that of wet chamois skin. The lesion is slightly salient, involves the superficial tissues of the glans and sometimes of the prepuce, and has sharply-defined borders, and gives rise to no secretion from its surface. It may involve more or less of the glans, and is sometimes continuous with an indurated nodule of the prepuce.

The umbilicated papule or follicular chancre is a rare form of the initial lesion, of which I have seen six cases. It begins as a small pinkish elevation of the size of a milium, with a minute depression in the centre, which grows slowly and assumes in form the appearance of a tumor of molluscum sebaceum. Further increase takes place until a pea-sized tumor is formed. As the lesion grows the central depression becomes broader and deeper, until in its full development the chancre is cup-shaped and as if set in the mucous membrane, with its borders markedly elevated. It is firmly indurated, sharply circumscribed, and the deeply concave surface smooth, glossy, of a deep-red color and exulcerated. In two cases the veins and lymphatics enlarged to the calibre of a goose-quill, extended along the penis, and the shape of the lesion could be compared to a miniature flute. In this form of chancre the syphilitic virus probably enters the duct of a Tyson's gland or one of the minute crypts or invaginations of the mucous membrane, and there

produces a subcutaneous nodule which develops in the manner just described.

The purple necrotic nodule is also a rare form of the initial lesion. (See Plate VI. Fig. 6.) It is always, according to my experience, found upon the glans penis or in the sulcus. It begins as a small dark-red spot, which soon becomes elevated. As it grows its color deepens; it becomes salient and roundedly convex on its surface. Palpation shows that it is of fine texture and perhaps of much density. In its period of full development it is a purplish papule with shining surface, about as large as a split pea, sometimes larger. It may happen that no visible degenerative changes take place in this lesion, in which event it slowly subsides, loses its color, and on its site a depressed pigmented cicatrix is left. Then, again, necrosis may occur in its whole extent. It slowly or promptly exulcerates and melts away, and when healing has taken place there is a distinct loss of tissue, as if the part has been taken out with a punch.

The ecthymatous chancre is simply a chancre which becomes covered with a pus-crust. (See Plate VI. Fig. 10.) It is developed from the dry papule or the chancrous erosion. The surface of the lesion becomes mildly exulcerated, and slowly a flat crust forms, which is of a brownish-black or greenish-brown color. The crust is formed of pus-cells, tissue, detritus, and numerous microbes.

The term "ecthymatous" might carry with it the impression that the lesion begins as a pustule. This it never does. It is simply a hard chancre which is mildly irritated on its surface, and as a result slowly becomes covered with a crust. In this particular only does this lesion resemble ecthyma. This form of chancre is found upon cutaneous surfaces, particularly of the penis and the juxta-genital parts. It may be found elsewhere on the integument. The lesion may be single and sometimes multiple.

The so called parchment-like chancre is simply a chancrous erosion in which the cell-proliferation is superficially distributed in a flat, disk-like form. It is usually found on the integument of the penis, the lesions varying in size from one-third of an inch to one inch in diameter.

The term "*annular chancre*" is applied to primary lesions in which the greater part of the new growth is developed in a ring-like form, the centre of the lesion being less thickened and infiltrated. Sometimes this ringed development is strikingly apparent; at other times it is less so. This form of chancre is found on the internal surface of the prepuce, sometimes on the glans, and again on cutaneous surfaces, particularly of the penis. (See Plate VI. Fig. 4.)

The indurated nodule is a localized mass of syphilitic cells which have developed by age and the activity of proliferation from any of the above-described forms of initial lesion. Whereas in some cases the infecting process is limited in its whole course to the upper part of the derma or mucosa, in many cases the infiltrations invade the underlying connective tissue. Then we have small circumscribed masses or small or large nodules. In the male these nodular lesions are most commonly found near the frænum and in the mucous layer of the prepuce near the coronal sulcus; also upon the meatus, sometimes on the glans and on the skin. These nodules may be very small—for example, of the size of a

large bird-shot—even near the frænum, in which case their nature is apt to be overlooked. Then, again, they occur in goodly sizes, as large as a split pea and larger, and as diffuse masses of an inch or more in thickness, and of corresponding breadth. In some cases the indurated nodule rapidly becomes covered with epithelium and then exists as a well-defined, sharply-limited lump in and under the skin. It, however, may have the appearance of the chancrous erosion, or it may become encrusted by the cream-gray false membrane which from many causes, as we have seen, sometimes becomes brown or greenish black. These indurated nodules in untreated cases remain for long periods—weeks and months—in an indolent condition, and then their size may be increased by a circumambient, hard œdema. The result is that a very large lesion is produced. In this state of aphlegmasic chronicity the surface of the lesion may become markedly papillated or warty, and it may then be mistaken for cancer of the penis. I have known a number of such errors where amputation of the penis had been decided upon.

These indurated nodules very often are extremely slow in disappearing, even under active local and constitutional treatment. (See Plate VI. Fig. 9.)

By the term "infecting balano-posthitis" is understood a development of the initial lesion in a diffuse plate-like form in the mucous layer of the prepuce, and also, sometimes, in the superficies of the glans. This lesion usually begins as a goodly-sized chancrous erosion, which spreads peripherally until more or less, or perhaps the whole, of the prepuce is involved in the hyperplastic process. The appearance of the parts is then striking. The prepuce is thickened, usually of a dull deep red, and has a velvety, excoriated appearance. Retraction of the prepuce becomes very difficult, and perhaps impossible. Not infrequently this condition of the prepuce coexists and merges with an indurated nodule or nodules at the coronal sulcus or frænum.

This infecting balano-posthitis is sometimes seen in a condition which has not hitherto been described. The infecting process then begins with little or no excoriation, and the parts are normal in color. The prepuce gradually becomes thickened, until more or less of its extent is involved in patches or disks. The color of the parts being normal, the surgeon is liable to overlook the nature of the process. I have seen several cases in which the only visible evidence of disease was that the inner layer of the prepuce was thrown into little transverse folds. On palpation a mild, diffuse, not well-circumscribed thickening is felt.

It is well to call attention to the fact that induration as a symptom depends entirely on the growth of the initial lesion. At first there is only a mild hyperplasia, but as the cell-increase goes on the hardening of the tissues occurs. In most cases fully ten days, even fourteen days and longer, elapse before we have that hard, indolent, circumscribed lesion which presents such a marked contrast to the features of diffuse, doughy, inflammatory hyperplasia.

CHANCRES OF THE URETHRA.—Chancres may be seated on one or on both lips of the meatus, but they most commonly involve the circumference of the urethra. (See Plate VI. Fig. 8.) In some cases there is no ulceration of any degree, the lip or lips of the meatus being scarcely if any redder than normal, and the only appreciable morbid process

being the condensation and induration of the parts. Induration here is usually very well marked. Sometimes one lip of the meatus and the wall of the urethra feel as if a thin plate of ivory was laid in it. This same condition is often found in both lips. Then, again, a distinct hard nodule may be felt at the distal end of the urethra.

Chancre at the meatus may be of the form of chancrous erosions, or it may present the typical cream-green tint, which may become of a deep dull-green, or even of a greenish-black, color. A diagnostic mark of much importance in this form of chancre is the purplish-blue color of the glans in a halo-like form.

Chancres, usually of the erosive form, are found down the urethra, even as deep as three or four inches.

All chancres of the meatus and urethra cause more or less impediment to urination. This is observed to be particularly severe in cases in which a temporary pinhead-sized stenosis of the canal has been produced by the infecting hyperplasia.

These chancres give issue to a scanty or moderately profuse sero-purulent fluid, which may mislead the surgeon into the belief that the case is one of anomalous gonorrhœa. In all cases which give a history of a painless affection with non-inflammatory, scant muco-purulent secretions the condition of the urethral walls must be examined with a view of determining whether a chancre is present.

CHANCRES OF THE SCROTUM.—In somewhat rare cases chancres appear on the scrotum, usually on its anterior or lateral portion, rarely on the back part.

The initial lesion in this locality is usually of goodly size, varying from that of a three-cent silver piece to that of a quarter of a dollar, sometimes even larger. Two varieties of lesion are commonly met with —the chancrous erosion and the encrusted chancre. (See Plate VII. Fig. 5.) The lesion is round or oval, somewhat elevated, having a smooth, flat, velvety surface when of the erosive type, and being somewhat concave or saucer-shaped when of the encrusted type. The false membrane which covers scrotal chancres is of the grayish-green color already described, but it may become yellowish and brown, and even black. These lesions are sharply marginated, and have a narrow red areola. There is usually not much induration connected with them, and if present it is of the parchment variety. There may be one or two chancres—rarely more than three. I once saw an inflamed and exulcerated wen on the anterior wall of the scrotum which had been mistaken for an exuberant hard chancre.

CHANCRES OF THE ANUS.—Chancres are found beyond the anal ring, at its margin, and within the ring as far up as an inch and perhaps farther. These lesions in this location do not usually present clearly-cut features. Without the anal ring they may be oval or round or of irregular outline. They are of a pale-rose, sometimes red, color, covered with a shiny secretion, and perhaps creased or fissured. Within the anal ring they are usually found in the shape of a sluggish hardened fissure. They are much less painful than simple fissures—a diagnostic point of much importance. A further point is that with this form of chancre there is marked enlargement of the inguinal ganglia.

EXTRA-GENITAL CHANCRES.—Chancres appearing on parts other

PLATE VII.

Extra-Genital and Uterine Chancres.

than the genital organs are called "extra-genital chancres." They are mostly found on the face, the neck, the arms, the fingers, the hypogastrium; but they may be found on any part of the body. They begin as a small dull-red papule, with more or less scaliness, which, if situated on parts in coaptation with another surface of integument, becomes a chancrous erosion, and in that form runs its course. Usually these chancres become encrusted. The crust at first is of a cream-green color, but this feature may soon be lost, owing to dust and dirt lodging on the lesion. Then we see flat, tolerably well-indurated disks of round or oval outline, which have a brownish-red margin which may be raised in a lip form. The greater part of the lesion is then covered with a chamois-skin-like or yellowish-brown or dark-brown crust.

These lesions have an average size of half an inch to an inch in diameter. In some cases their extent is even greater. About the cheeks they may develop into regular tumors of the size of a horse-chestnut or of half an apple.

CHANCRES OF THE GENERAL INTEGUMENT run a chronic, indolent, painless course, and may last one or more, and even six, months before sinking down and fading away. They usually give rise to no painful symptoms, and early in their course they have no concomitant except the painless enlargement of the lymphatic ganglia of the region upon which they are developed. When they finally undergo resolution, they leave purplish, brownish-red, and brownish-black pigmented spots, with more or less atrophy and cicatrization of the skin, which last for a long time.

Chancres of the Fingers.—These chancres are found most commonly among surgeons, obstetricians, dentists, midwives, and nurses male and female. In these individuals the infection is usually contracted in operations and examinations, either upon a newly-made cut or an abrasion, excoriation of the skin, or upon some simple lesion present upon the skin, as, for instance, eczema and dermatitis due to the use of antiseptics. Among the laity chancres of the finger are not very common, and they are, as a rule, the result of libidinous toying with the genitals of an infected woman. Finger-chancres also result sometimes from the bite of a person having syphilitic lesions in the mouth, and they have been known to follow a blow delivered upon the mouth of a person suffering there from specific lesions.

These chancres form on some part of the margin, also on the sides and on the pulp, of the finger and along its continuity. There is generally but one chancre, sometimes two, and rarely more.

On the finger we find the scaling papule or tubercle, the excoriated or exulcerated nodule or mass, the fungating chancre, and the panaritium-form chancre.

The scaling papule or tubercle is the rarest of all forms of finger-chancre. It is usually formed on the dorsal surface of a phalanx, and sometimes on the sides and palmar surface of the fingers. It begins as a papule, and runs its course as a tolerably well-circumscribed, indurated, and more or less scaly lesion of a dull copper-red or purplish-red color. When near joints the chancre may become more or less exulcerated.

The excoriated or exulcerated nodule or mass is the most common form of chancre of the finger. It is, as a rule, found near the tip of the

finger. It usually begins as a small pustule, a m
fissure or hang-nail. The cell-growth increases
in its early days is indolent and painless. In a
becomes fully developed into a large, fleshy, s
even lumpy, mass of dull-red color, sometimes
There may be density in the morbid tissue, bu
induration. Very often the chancre is soft and p
being exuberant in development, produce much
affected. Their shape depends on the site upon wh
They are sometimes the seat of severe and continu
or isolated, these chancres remain in an indolent co

The Fungating Chancre.—This form of finger
rule, on the pulp of the organ and around the last
decidedly papillomatous mass, sometimes of much e
which is indolent in its course, and often presents
and not uncommonly a purplish-red color, in s
gray. This form of chancre may be attended wi
Its course is chronic and indolent.

The Panaritium-like Chancre.—This chancre
integument of the nail-margin in a cut or fissur
inflammatory lesion. (See Plate VII. Fig. 6.)
spot forms, which may be localized to one part
the latter may be wholly involved. When fully
encrusted or exulcerated swelling of more or less
frequently becomes covered with a yellowish-gree
brane, and the thickening of the chancre extend
This lesion is may be attended with pain during i

In almost all cases of finger-chancre develope
or tip more or less of the appendage is destroye
whole extent.

Much ultimate deformity is very often prod
chancres, both in the nail and as to the symme
finger. In somewhat exceptional cases septic in
tants of finger-chancre.

Usually the epitrochlear ganglion in anatomic
affected member is enlarged, often to a considera
that of a nutmeg to that of a horse-chestnut.
perceptible enlargement of the epitrochlear ganglia
of the axillæ are much swollen. There is usuall
lary ganglia concomitant to that of the epitrochlea

Cases of syphilitic infection of patients by s
and midwives having chancres on their fingers are
Such persons thus affected should not perform oper
inations upon any patients.

It is a peculiarly striking fact that physicians
slow to appreciate the nature of chancres on the fi
delude themselves with the idea that the lesion is
obstinate in its course, and they consider it due to
than that of syphilis. In the majority of cases it w
a physician, surgeon, obstetrician, or midwife has a
indolent sore on his or her finger the lesion is in

infection. It is a good rule to always be suspicious of an indolent sore of the finger in professional people.

In some rare cases chancres of the fingers become contaminated with infectious material, and more or less pyæmia or septicæmia appears to complicate the case.

Chancres of the Lips.—Chancres of the lip are quite common. They are usually seated on the vermilion border, sometimes on the inner border, and again on both the vermilion border and the skin. They may be seated on the cutaneous portion of the lips alone. These chancres are rarely seen early in their course, since their nature is frequently unrecognized until they have reached full development. They begin as small round or oval excoriations or fissures, and are at first looked upon as cold sores or cracks of the lips. (See Plate VII. Figs. 1 and 2.)

It sometimes happens that a minute excoriation or small fissure will run a very ephemeral course, and disappear in a week or ten days without having or leaving after it any induration. In these cases the only early sign of syphilitic infection is the marked enlargement of submaxillary and sublingual glands. But in most instances chancre of the lips goes on to full development, producing a raw, eroded nodule whose shape is in conformity with the arrangement of the parts, or an encrusted lesion is produced. The color of the membrane covering these chancres is of the greenish-cream or deep-green, which is oftentimes so darkened by minute hemorrhages that a dark-brown crust is left. In many cases the lip-chancre is tolerably well defined, sometimes resembling the rounded nodules seen on the penis; then, again, the chancre is spread out along the vermilion border. The amount of induration varies; in some chancres the ephemeral induration cannot be felt, in others it is moderate, but somewhat doughy, while it may be found of great extent and of ligneous hardness. These chancres cause much discomfort by their presence on the lip, and the concomitant engorgement of the glands is often a source of annoyance and even pain.

Chancres of the eyelids may be found either of the erosive or encrusted form. (See Plate VII. Fig. 3.)

Chancres of the Tongue.—These chancres have not clearly marked features. They appear as tolerably well-circumscribed nodules, either at the tip or on the lateral portion. Their surfaces are red, eroded, sometimes covered with a milky pellicle, frequently uneven and traversed by minute fissures. Their nodular character, chronic, indolent course, and external features point to their nature. The submaxillary glandular enlargement aids in making the diagnosis. It must be remembered that cancer of the tongue begins in a little nodule, perhaps warty in appearance, and is soon complicated by glandular enlargement. In persons under forty or fifty years of age it will generally be found that the tongue lesion is of syphilitic origin. In middle and advanced age the probabilities are greater that the lesion is cancerous than that it is syphilitic. In these cases every phase should be carefully studied, in order that a correct diagnosis may be made.

Chancres of the Gums and of the Hard Palate.—These lesions are very rare indeed, and several cases reported as such were undoubtedly

those of hypertrophic mucous patches. The surgeon should examine and think long before pronouncing as chancres localized red thickening of the mucous membrane of these parts. When they exist these chancres are simply hypertrophied chancrous erosions, the so-called ulcus elevatum. Owing to the condition of the parts, it is difficult to determine the extent of the induration.

As a rule these lesions cause little trouble and are attended with scarcely any pain when unirritated. When seated near the margin of the gum they may be attacked by ulceration.

Chancres of the Tonsil.—These chancres are now known to be sufficiently common. The comparative frequency to-day of the tonsillar chancre is due to the fact that its existence is now well known, and that surgeons are on the lookout for it. I have seen fully eighteen cases, and perhaps more.

The tonsillar chancre never presents a definite typical appearance, since the tissues upon which it is seated differ in each individual. Whatever may have been the conformation of the parts, whether moderately smooth or more or less anfractuous, the chancre lesion will be but an exaggeration of that condition, due to hyperæmia and hyperplasia of the parts. Examination is difficult in all cases, particularly so in some. When accessible to the finger-tips the tonsil-chancre will feel quite hard, and may be even cartilaginous. In some cases the new growth is tolerably well circumscribed; in others it is quite diffuse, involving a whole tonsil and the tissues around it. The surface of the chancre may be simply red and superficially eroded; it may be covered with a milky-looking membrane, in which case it may look like a mucous patch; then, again, a dull-green membrane of considerable firmness may cover the lesion.

In most instances there is but one chancre, involving more or less of one tonsil. I once saw a case in which there was a well-marked chancre on each tonsil. Then, again, I saw during its whole course a chancre which involved the two tonsils and the posterior pharyngeal wall. At about the time this case was under my care a colleague sent me a similar one for diagnosis.

These chancres usually become troublesome quite early in their course. The patient complains of pain, uneasiness, and of a difficulty in swallowing. Sometimes the suffering is very great. Then the submaxillary, sublingual, and lymphatic ganglia swell up very much indeed, so as to produce large-sized bunches in the neck. These by their size impede motion and deglutition, and add materially to the patient's suffering. The ganglia become matted together into hard, firm, indolent masses. In some cases the pre-auricular ganglia are enlarged.

Such is the deformity of the parts, and so great is the discomfort of patients with these chancres, that it may be necessary to begin treatment before the date of evolution of the secondary stage. Usually these lesions yield promptly to energetic treatment.

The diagnostic features of these chancres are—(1) the history of the case; (2) the slow, painless enlargement of the ganglia; (3) the unilateral seat (usually) of the lesion and its appearances; (4) the absence of chancre elsewhere and the markedly less engorgement of the ganglia of other parts of the body; and (5) the evidences of constitutional syphilis.

CHANCRES IN WOMEN.—Chancres in women are less regular in their course than they are in men. In some women the chancre is so very small, benign, indolent, and ephemeral that it may pass unseen or its nature be overlooked. Its characteristics are very often marked by inflammatory complications. In women induration is not generally so well marked as in men. In many cases this symptom is not well marked, and frequently it cannot be detected on account of the nature and inaccessibility of the parts. In some cases, however, an extreme condition of induration as to extent and density may be observed.

In women we find about the genitals the chancrous erosion; the scaling papule or tubercle; the elevated papule or tubercle (exulcerated —ulcus elevatum); the encrusted chancre; the indurated nodule; and the diffuse exulcerated chancre.

The chancrous erosion is found upon the surface of the mucous membrane. It begins like a little red spot, resembling a ruptured herpetic vesicle or excoriation. Its early appearance is so deceptive that its nature is frequently overlooked. In these and other particulars it resembles similar lesions in the male; hence it is not necessary to repeat the description given of it as it appears in that sex.

This lesion may run its course as a flat erosion with little if any very perceptible induration. Then, again, it may become salient from cell-hyperplasia, and it then may be termed a papule or tubercle. When developed on uneven and anfractuous parts the lesion moulds itself in conformity therewith.

The scaling papule or tubercle is found upon parts which resemble in their structure the integument, such as the labia majora and minora when long, and the prepuce of the clitoris when unusually long. This form of initial lesion may be as large as a split pea or a five-cent nickel piece, or even as large as a silver half-dollar. It is usually round, sometimes oval, in shape. There may be parchment-like or deep induration with this form of chancre.

Usually these chancres run an indolent course. They become of a coppery-brown or of a reddish-brown, even purplish, hue, are more or less scaly, moderately salient, and painless. If irritated, their epidermal covering is cast off, exudation from the surface occurs, and the lesion is transformed into an encrusted chancre. This lesion may last for weeks, and even several months. It disappears slowly, and on its site is left a patch of pigmented, perhaps scarred or atrophied, skin.

The elevated papule or tubercle (ulcus elevatum) presents the appearance of a flat, circumscribed, somewhat elevated lesion of the type of the chancrous erosion, of which it is only a further stage of development. Its surface is, when unirritated, smooth and velvety, but as the chancre grows older it may become more or less papillated. Usually considerable induration accompanies this lesion either in parchment-like form or, not commonly, as a nodulation. Its course is indolent and chronic.

The encrusted chancre is simply one of the preceding lesions which has become covered by a crust. This does not usually occur when two layers of mucous membrane are in more or less close coaptation. This form of chancre may be found on the outer portions of the labia majora and on their margin, on the labia minora, and on the tip of the clitoris when long.

The indurated nodule is very rare in women, in whom the initial neoplasm tends to spread itself in the soft tissues. When present this form of chancre is found on parts where the skin and mucous membrane fuse together. It consists of a firm mass of indurated tissue, somewhat elevated, sharply marginated, with saucer-like surface, which may be smoothly eroded or covered with a characteristic crust.

The diffuse exulcerated chancre is found in women of the lower order, to whom care of the person is unknown. It is simply the chancrous erosion or the elevated tubercle much enlarged and complicated by profuse hard œdema.

Hard œdema very frequently complicates chancres about the vulva and introitus vaginæ. It consists of a dense, indolent firmness of the tissues, which may be of moderate extent or of exuberant development. By it the labia, large and small, are frequently much enlarged in whole or in part; their symmetry may be lost thereby, and so great may be the hypertrophy that actual disfigurement and deformity are produced. This complication of chancres in women runs a very indolent course. When not of very large extent resolution may take place under treatment, but in many cases so large and extensive is the new growth that ablation must be resorted to.

Chancres of the vagina are very rare. When seen they are usually just within the vaginal ring, and are seated on the anterior surface of the vagina, in the sulcus on each side of the prominence formed by the neck of the bladder, or on the posterior walls. The thickness of the vaginal mucous membrane undoubtedly offers a barrier to syphilitic infection. One case of chancre about three inches up the vagina has been reported.

The vaginal chancre is a round or oval, well-circumscribed lesion of the erosive type, with or without elevation. It may also become encrusted, in which case it is indolent, secretes little sero-pus, shows little if any ulcerative tendency, and has a deep-green or brownish-green color.

Chancres of the os uteri are more frequently found now-a-days than they were, for the reason that they are looked for and their nature is now recognized. (See Plate VII. Fig. 4.) They are of the erosive or elevated type of chancre in some cases, but most commonly they are encrusted. They are found on either lip, and also they may surround the os. Their surfaces are not usually very smooth, but they have sharply-defined outlines. The incrustation may be of a yellowish-green tinged with brown, or it may be of the cream-green tint already spoken as being seen in chancres in men. With these chancres there is more or less induration, which is usually difficult to make out. In some cases there is complicating hard œdema, which causes the lower part of the organ to be much hypertrophied. These chancres usually run an indolent, painless course, though in exceptional cases the duration is markedly ephemeral.

Chancres of the Breast.—Chancres are found upon the female nipple, upon its areola, and rarely upon the integument beyond the areola. These chancres are particularly interesting both as to their mode of origin and their clinical history, with the consequences they may entail.

These chancres are of the erosive and encrusted types, and sometimes exist as indurated fissures.

Upon the nipple the chancre forms a flat plaque of varying size or a distinct nodule involving part or all of the appendage. When the woman does not give the breast to her child, the chancre shows a tendency to become encrusted, but during nursing moisture keeps the parts in an eroded condition.

Chancres very commonly form in the furrow at the base of the nipple, and then they assume shapes resembling segments of circles, and sometimes are completely circular in form. These chancres are most commonly of the encrusted variety.

Chancres of the areola are usually small round or oval erosions, sometimes flat, again elevated, or they may be saucer-shaped and slightly depressed below the normal plane. Very rarely do these chancres become encrusted. In this situation it is rather more common to find several chancres than one. There may be six or eight, or even as many as sixteen, of these chancres. In some cases these lesions are found on both breasts.

The indurated fissure is not commonly seen. It is really the nipple-chancre complicated with one or more very well-marked fissures.

In the majority of cases of chancre of the breast the infection is derived from hereditarily syphilitic children in whose mouths mucous patches are seated. This mode of infection occurs chiefly in hospitals and in lying-in asylums, in which vigorous and healthy lactating women are made to nurse one or more children besides their own. Owing to carelessness in examination on the part of the visiting staff or of the internes of these institutions, the buccal lesions of syphilis in some nurslings are overlooked or wrongly diagnosticated as of simple nature, and as a result the luckless woman whose duty it is to nurse these infants becomes infected with syphilis. I had under observation many years ago a woman who was thus infected in one of our city institutions, and in the essay in which it is narrated I considered the subject in all of its phases. Many other similar cases have been reported by Continental authors.

Another mode of infection of the breast with syphilis is from the secretion of hard chancres in the mouth of nursing infants. These cases are usually met with in private practice. The child is, as a rule, infected by some relative, friend, or chance acquaintance, who, having mucous patches in the mouth, implants the virus on the child's lip or lips. In due time the chancre appears (and it is commonly not large or much indurated), and by it the child's mother or nurse is infected at the breast.

In this way syphilis is often introduced into a family, and all its members may become its victims. Farther on in this section another mode of infection of the infant is described.

Chancres of the female breast are not infrequently seen which have been acquired in kissing from the infected mouths of lovers or husbands. Then, again, men are sometimes infected on the nipple from the kissing and dalliance of women with infectious mouths. I have seen two such cases.

Chancres of the breast appear as chancrous erosions, as encrusted or ecthymatous chancres, and as indurated nodules and fissures.

In many cases but one chancre is present: this is particularly true when the nipple alone is involved. Out of 56 chancres of the breast seen by Fournier, in 30 cases there was but one chancre, and in 26 there were several. When seated on the areola there may be but one chancre, sometimes several, and occasionally many. I have seen sixteen in this situation, and Fournier speaks of a case in which there were sixteen chancres on the right and seven on the left mammary areola.

Evolution of the Secondary Period.

During the two periods of incubation which constitute the primary stage of syphilis, which lasts on an average from fifty-five to seventy days, the manifest lesions are the chancre and its lymphatic complications.

There is a remarkable variation in the amount of systemic disturbance at the beginning of the secondary period, when it is thought by some that the disease really becomes constitutional, though it is certain that from the inception of the infection the various morbid processes have been maturing. In many subjects no deviation whatever from the healthy standard is observed to mark the commencement of the secondary stage, and the dermal lesions are the only evidence of syphilis. In others, however, particularly in women, much and varied constitutional disturbance takes place.

Perhaps the most constant morbid symptom is fever, which, though absent in many cases, is present in most in varying degrees of intensity. In some cases there is an elevation of temperature of from one to three degrees, commonly with a corresponding mild nocturnal exacerbation. In other cases the febrile movement is well marked, the morning temperature being from 101° to 102° F., and in the evening 104°, and in rather exceptional instances higher, even to 107°, particularly in women. This fever may be continuous, intermittent, remittent, or irregular. It may cease spontaneously, but is markedly under the influence of mercurials. It is often seen to be correspondingly severe, coincidently with a very profuse and extensive exanthem, particularly of the erythematous variety. In many cases a mild rise of temperature appears coincidently with a relapse of secondary manifestations, especially when the latter are severe. In the intermittent and remittent forms of syphilitic fever, though there is no chill, patients complain of a chilly feeling toward evening, which is accompanied by a feeling of lassitude, soreness of the whole body, and headache. The subsequent sweat, which is not constant, amounts to a slight moisture, but in some instances is quite well marked. In cachectic subjects and in those who are early attacked with cerebral symptoms this fever sometimes assumes a typhoidal type. Besides the elevation of temperature, there is a corresponding acceleration of the pulse and the respiration-ratio is increased. The tissue-metamorphoses are present in proportion to the intensity of the fever.

Various neuralgic pains are also complained of by patients, the peculiarity of which is their quite constant occurrence toward dark and at night. Headache, mostly nocturnal in character or continuous, with paroxysms toward night, is a very constant symptom. It exists in various degrees of intensity, from a mild and endurable form to one in which the patient's sufferings are agonizing, in which he or she is tor-

tured by pain during the night, and prostrate, worn-out, and suffering during the day, when the pain may not wholly cease. Neuralgic pains affecting the cranial nerves, the fifth in particular, also seated in the intercostal nerves, in the sciatic and its branches, and in the anterior crural, are not uncommon. Persons who have previously suffered from neuralgia of any part are especially liable to exacerbations during the eruptive stage of syphilis, and, in fact, at any time during the activity of the disease.

Insomnia is a symptom sometimes complained of by syphilitic patients, who can give no reason for it whatever, since in many cases there is no physical suffering. It is peculiar in the fact that it is not readily influenced by soporifics, but gradually ceases with the disappearance of the exanthematic symptoms under mercurial treatment.

In some exceptional cases, particularly in women, a mild and temporary aberration of the mind is observed in the form of emotional disturbances, hallucinations, delusions, and morbid impulses. Pains in the muscles and joints simulating rheumatism and occurring at night are most constant at the evolution of, and during, the secondary period.

The tendency to anæmia in early secondary syphilis is in many cases well marked. The diminished nutritive qualities of the blood and the impairment of the nutrition of the tissues are shown in the pale, sallow, and emaciated facies, in the palpitations and the small thready pulse and shortness of breath, in the want of appetite and energy, in the nervousness, restlessness, and apprehensiveness, and in the great languor, amounting often to dejection.

While in most cases this formidable combination of symptoms is gradually dispelled by treatment, and a healthy tone, mental and physical, is restored, in many, particularly in persons of poor fibre, in those suffering from visceral diseases and from adynamic conditions and other morbid states of the system, this cachexia and asthenia may persist, and require the most intelligent management, therapeutical, hygienic, and climatic, to successfully combat it.

Relapses of anæmia, cachexia, and asthenia are common during the whole course of the infection.

During the secondary course of syphilis a peculiar susceptibility of the skin and mucous membranes to irritation and inflammation is quite constantly observed. It is seen in the reaction caused by cuts, abrasions, burns, and incised wounds. In this stage gonorrhœa is often seen to become very virulent and its pus auto-inoculable. Herpetic vesicles readily become inflamed and present the appearances of chancroids.

Various forms of pus and muco-pus when inoculated give rise to ulcers having all the attributes of chancroids. Infiltrations of the skin are produced by causes otherwise trivial, and wounds, bruises, and ulcers are frequently complicated by infiltrated areas.

During the secondary period, particularly in women, certain changes are sometimes observed in the sensibility of the skin. This condition, which consists in loss of the sense of touch, of heat or cold, and of the perception of pain, is called "analgesia." It is mostly found upon the backs of the hands and forearms, also on similar aspects of the feet and ankles, and, in exceptional cases, it extends over the whole body. I have seen it in both the male and the female.

The course of syphilis is remarkably uncertain, and is seen in all degrees of mildness and in every form of severity. Constitutional peculiarities, habits, and surroundings are at the bottom of this morbid action. Some patients suffer very mildly from syphilis, even when they do not follow treatment, while others, again, are sorely punished. The benignity of syphilis in America, which is claimed by some authors, is dependent upon our more minute knowledge of the disease, upon improved methods of treatment, and upon our improved hygenic conditions and better food-supply than is obtained in some older countries. Take away these powerful factors for good, and syphilis would in a few years be equally as malignant as it was years ago. In the majority of cases patients otherwise healthy experience very little trouble from syphilis, provided they pursue a proper treatment for a sufficient length of time, avoid alcoholics, husband their strength, and exercise watchfulness of their general well-being. It is said that patients of light complexion and reddish hair suffer more severely than those of dark complexion—a statement which is in the main correct. But although the epithelial tissues and the integument of these patients are so frequently —and we may perhaps say persistently—attacked, the prognosis, in the long run, is good if their bodies are otherwise sound and their habits exemplary.

In youth and old age syphilis is especially severe. As regards youth, this statement must be thus modified: In young children suffering from hereditary syphilis the disease is, as a rule, severe and even deadly, but in the acquired form of syphilis of children there is really no remarkable malignancy. In old age syphilis is always a grave disease. Its stages are peculiar in the number, severity, and even malignancy of its lesions and coexistent systemic disturbance; tertiary lesions are prone to appear, and the disease intensifies morbid conditions, hereditary or acquired, visceral or nervous.

The existence of scrofula, tuberculosis, neuropathic conditions, rheumatism, gout, scorbutus, the hemorrhagic diathesis, and visceral diseases renders the prognosis of syphilis more grave. Alcoholic addiction is always a most serious complication of syphilis.

SYPHILIDES.

General Considerations.—The term "syphilides" is applied to the various lesions of the skin symptomatic of syphilis, in preference to the term "syphilodermata," which, besides being inexact, is decidedly not euphonious. Syphilitic eruptions appear during the course of the disease, both early and late. They embrace all forms of eruption, from erythema to nodular infiltration. They are the result of hyperæmia and cell-increase, the hyperæmic eruptions being, as a rule, peculiar to the early periods, while those composed of cell-infiltration appear later and very late in the disease. The infiltrating cells belong to the class of granulation-tissue. The most simple forms of infiltration lesions are papules, which appear in early and intermediary periods, while the more advanced lesions, tubercles, as a rule, appear later.

The dermal lesions of syphilis are in many respects similar to those of simple origin, consisting of erythema, papules, pustules, vesicles, bullæ, and tubercles or nodes.

This correspondence between simple and syphilitic skin lesions leads to the use of the terms (following the classification of Willan) of syphilitic lichen for papular eruptions; syphilitic impetigo, eczema, and psoriasis for pustular and scaly rashes; and syphilitic lupus for tubercular eruptions. Nothing but inexactitude and uncertainty can result from such a nomenclature. We shall use the simple, practical, and exact division as follows: erythematous, papular, pustular, pustulo-ulcerative, and vesicular syphilides among secondary lesions, and tubercular, bullous, tuberculo-ulcerative, and gummatous among the late or tertiary lesions. A minute knowledge of the syphilides requires, as a groundwork, much familiarity with simple eruptions.

The syphilides present certain peculiarities and undergo various morphological changes. In their course they exhibit a chronicity and absence of inflammation which are in marked contrast with those of simple eruptions. Though, exceptionally, the erythematous and papular syphilides appear with a brusque and rapid onset and with considerable systemic reaction, they soon subside into the subacute and aphlegmasic condition peculiar to them.

Absence of itching, irritation, and pain is the rule with syphilitic eruptions. In some cases of early and acute evolution the erythematous and papular rashes may be attended with a mild and ephemeral pruritus. Early rashes on the scalp sometimes itch moderately, as they also may on the legs and forearms. It must be remembered that a pruritic condition of the skin from internal and external causes may coexist with syphilitic eruptions. Pain may accompany the tubercular or gummatous syphilides when developed in the course of a nerve, or it may follow the cicatrices of these lesions which compress a nerve or nerve-filament.

Owing to their chronicity, their tendency to relapse, and to the changes which the lesions of syphilides undergo, polymorphism, or the simultaneous occurrence of several orders of lesions, is very frequently observed, particularly in the early, but also in the late, stage.

The color of the syphilides is less frankly red than of simple eruptions, and varies from a pinkish-red to a deep brownish-red or coppery color or to the hue of the lean of ham. When, exceptionally, the red of syphilitic eruptions is at first well marked, it very soon becomes less intense and more subdued. Early erythematous and papular syphilides may be rendered temporarily pale by pressure, but later on, owing to pigmentary changes, the color is unaffected. These pigmentary changes, though very frequent in syphilis, are also observed in such simple eruptions as lichen planus, dermatitis, eczema; in fact, in any eruption which runs a chronic course.

The early eruptions of syphilis most commonly resemble the exanthemata in their general and symmetrical distribution. Relapses, particularly of the erythematous and papular syphilides, are less extensive, and are prone to appear symmetrically on certain regions and to assume a circular form. This is especially noticeable upon the neck, on the forearms, near joints, and also on the anterior surface of the legs.

Such is the belief in the infallibility of mercury in the cure of syphilitic eruptions that it has been considered as the test of their diagnosis. The facts are, that the early and infiltrative lesions are very amenable to

the influence of mercury, particularly when given before they are old, but when they become chronic, scaly, ulcerative, and more or less cicatricial they are very often rebellious.

Syphilitic eruptions, besides their essential physiognomy, show a tendency to peculiar localization. The secondary lesions appear in scattered form on the scalp, at its margin on the forehead and at the nucha, on the ala nasi, at the angle of the mouth, about the anus and genitals, around the umbilicus, upon the palms and soles, around the nails, on the nates, between the toes, and particularly on the extremities near joints on both flexor and extensor surfaces. As the disease grows old the eruptions, which at first were general and symmetrical, show a tendency to become localized on certain regions symmetrically, and later on to become unsymmetrical.

The course, polymorphous changes, and the sequelæ of the syphilides will be considered separately with each variety.

THE ERYTHEMATOUS SYPHILIDE.—This eruption has been called syphilitic erythema, syphilitic roseola, macular syphilide, syphilis cutanea maculosa, syphiloderma erythematosum,—all of which names are more or less faulty or objectionable. The application of the term "macular" to this syphilide is positively wrong, since it conveys the idea that it is composed of macules, whereas it is really formed of erythematous spots, which later on may become macules or stains. Consequently, if we admit a macular syphilide—which is irrational and unnecessary—the term may apply to an old erythematous eruption, and equally to the pigmented sequelæ of any other form of syphilide.

The erythematous syphilide is usually the earliest and most constant dermal lesion of the disease. It probably exists in all cases of syphilis, and is sometimes first recognized either by reason of limited distribution or of its very faint development. It commonly constitutes the whole eruption, but often coexists, even at the invasion of the disease, with papules and even pustules.

The lesions composing the eruption consist of round or oval and irregular spots of hyperæmia, varying in diameter from a line to one-third or one-half an inch. At first their color is usually of a very delicate pink, so light in some cases that the eruption looks like a very faint mottling of the skin. In others it is even less perceptible, and can only be seen by exposure of the parts to cold air or water, and it becomes lost in the subsequent hyperæmic reaction. In outline the spots may be sharply marginated or ill-defined. They are not appreciably elevated, and at first not covered with scales. In this form we constantly see a mixture of pea-sized spots with those having a diameter of a third of an inch.

In marked contrast to this very subdued form of the erythematous syphilide is the more intense form, which is also frequently seen. In this variety the eruption begins as a pinkish or rosy spot, which quite rapidly becomes darker until a rather deep pinkish red is observed. The spots are, as a rule, of a diameter of one-third or one-half an inch, presenting considerable uniformity, and often dotted with pinhead-sized punctæ of deeper red, corresponding to the orifices of the sebaceous and perspiratory glands, where it is probable that the hyperæmia is more intense. In this variety there is no elevation of surface, the spots are

sharply marginated, and very soon become covered with minute scales.

There is a third form of the erythematous syphilide, not at all uncommon, but which has not been clearly described. It consists of small, well-marked, subdued-red spots, having a blotchy or irregular outline, oftentimes gradually lost in the surrounding skin, and averaging from two to four lines in diameter. These spots, besides being readily seen, are easily felt as very minute little rough prominences of the skin. The lesion is, though elevated, not at all papular, and close inspection shows that its salience is due to the marked localized hyperæmia, particularly around the follicles. This eruption has an individuality of its own, is wholly different from the *roséole papuleuse* of the French, comes out with tolerable promptness, and is seen in its most characteristic form on the anterior aspect of the trunk, less so on the back, limbs, and face, where its so-called elevation is less marked. It is blotchy, persistent in its course, becomes scaly quite early, and on its decline subsides into small pigmented spots.

In their course these three clinical forms of the erythematous syphilide present considerable variation. The pale-rose or pinkish eruption, which so often escapes detection, is usually of ephemeral duration. The spots rarely become elevated, and more rarely the seat of scaling, and they disappear as they appeared, suddenly and quickly. It is not uncommon to see this eruption in its subdued form coexist with well-defined erythematous spots on the face, forehead, and the flexor surfaces of the arms. While, in general, the concomitant systemic disturbance is mild, very often it is severe with this rash.

The second or more hyperæmic form of the erythematous syphilide usually appears by prompt and comparatively rapid invasion, and is often accompanied by marked elevation of temperature, malaise, rheumatoid pains, and neuralgias. The irregularly and generally distributed spots are at first of a grayish-red, which soon assumes the purplish tint. Very often, with this deepening of color, punctæ of even deeper hue appear at the orifices of follicles. Again, at these follicular openings circumscribed cell-increase occurs, forming very minute papules, which has given to the eruption the name *roséole piquetée*, or granular roseola. In some cases, usually in only a certain number of spots, there is, besides the hyperæmia, moderate cell-increase into the papillæ, producing a slight salience of the lesions—a condition called roséole papuleuse and roseola urticata.

This form of the erythematous syphilide is peculiar for its chronicity, since the purplish spots remain unchanged for weeks, and perhaps as long as three months. Then they gradually become grayish brown, then coppery, and finally a yellowish buff, when they disappear, the process of involution sometimes occupying several months. More or less desquamation is often observed in this syphilide from its period of development to its decline.

The faint and the dark forms of this eruption may consist of numerous closely-packed and generally-distributed spots or a more or less sparse eruption. In some cases, particularly of the dark spots, coalescence into patches of a number is seen, chiefly about the joints or on parts subjected to pressure and irritation.

The tendency is well marked in all forms of the erythematous syp
lide to appear first in the region of the umbilicus and on the hypog
trium, and from there they invade, in some cases slowly and in oth
quite rapidly, the whole trunk and extremities, showing preference f
but not being confined to, the flexor aspects, and being very often loc
ized and persistent on the palms and soles, where they very commo
form small and large, discrete and confluent, scaling patches, and of
on the thorax, following the obliquity of the ribs. The face, chiefly
forehead and the cheeks, is also frequently invaded, while in ma
instances the eruption is seen on the hairy scalp, where it is commo
accompanied with alopecia. About the neck, chiefly at the hairy m
gin, it is also seen, and very often in quite large patches, owing to irri
tion of the collar or clothes. Physical exertion, hot baths, high te
perature, acute mental emotions, and alcoholic stimulants are occasio
causes of the abnormally rapid evolution of this syphilide. The mor
less active circulation of the patient has a marked influence on
intensity or mildness of the specific erythema.

In its course the punctate form of the erythematous syphilide is f
quently as chronic as the purplish form. The red and slight cen
elevations slowly subside with desquamation until the whole patch
no longer salient, and the dull red gradually turns into a coppery h
and from that to a yellowish buff, until it is finally lost.

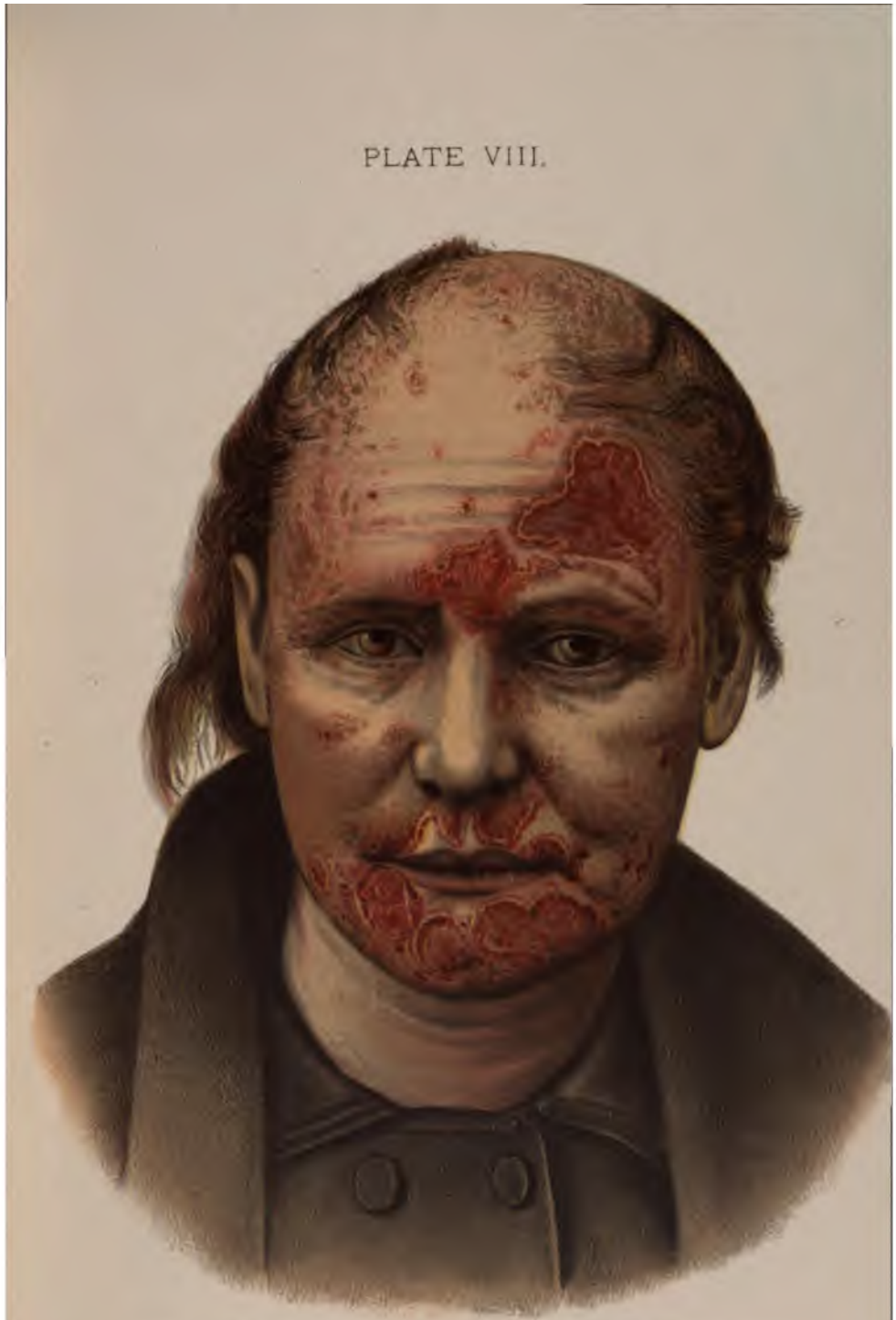
In some cases, more especially those in which the eruption lasts q
long and in which treatment has not been active, it is not uncommo
see a more or less copious papular syphilide developed among
patches of erythema, or perhaps grouped in certain regions, such as n
joints or about the head.

Relapses of the erythematous syphilide are not uncommon, but t
present the peculiarity that the second rash does not follow immediat
or soon after the first, which is, as a rule, followed by one of the papu
or pustular order, but later on, at periods of from four to six month
a year and a half in very exceptional cases. Many instances of w
seem to be true relapses of this syphilide are caused by accidental s
temic disturbances produced by changes of the season, nervous exc
ment, and alcoholic indulgence. I have many times observed
coincidence, the nature of which it is important to determine, owing
the disquieting effect upon the mind of the patient of the thought t
his disease has returned to its original form.

While it is not common, it certainly is not exceptional, to see a g
eralized erythematous syphilide appear as a relapse. It is uncomm
however, to see the deeply hyperæmic purplish form of this syphil
thus reappear.

By far the most common form of relapse of this syphilide is a sy
metrical and less copious and extensive eruption, and limited to cer
regions, such as the anterior aspect of the trunk, the forearms, near
joints, the wrists particularly, the thighs and buttocks, and about
forehead, nose, mouth, and chin. In these somewhat sparse and locali
relapses the erythematous syphilide shows a marked tendency to assu
the circular or ringed form, which is rarely seen in first exanthems,
is well shown in Plate VIII., in which the somewhat unusual feat
is portrayed of the rings becoming markedly salient. I have seen t

PLATE VIII.



ANNULAR FORM OF THE ROSEOLOUS SYPHILIDE

tances of rather late-relapsing erythematous syphilide in which, at flexor surface of the elbows and in the popliteal spaces, the eruption med diffuse patches, over which were scattered a number of perfect ks of unaffected skin varying in diameter from one-third of an inch an inch. In some cases the erythematous spots become covered with asy scales, which show the combination of seborrhœa with the syphi- c process. (See Fig. 198.)

In most cases of relapse there is an absence of the combination of ere systematic symptoms so often observed with the first eruption. The

FIG. 198.

Erythematous syphilide with seborrhœic complication.

emperature may be normal, slightly raised, or much elevated. Being he most prominent of the early manifestations, this syphilide is always ssociated with a greater or less number of other lesions, a constant one eing the chancre. Erythema of the fauces, erythematous patches ex- oriated by reason of coaptation of surface, papules of hairy parts,

pustules, condylomata lata, alopecia, and affections of the nails are frequent concomitants; to which may be added iritis and periostitis.

Diagnosis.—In its hyperæmic stage the erythematous syphilide may be mistaken for rubeola, scarlatina, or the erythemata from copaiba, sandal-wood oil, and other drugs. The mode of invasion—which is rarely as markedly acute as that of the exanthemata and of drug-eruptions—the absence of the high fever, the catarrhal and conjunctival and gastric symptoms of the simple exanthems, the circumscribed and indolent character of the rash, the history of the case, the concomitant lesions and symptoms, will readily indicate its syphilitic origin. Should a mistake occur, the persistence of the syphilitic rash is in such marked contrast with the evanescent course of the exanthemata and drug-eruptions that the error would soon be corrected.

Pityriasis versicolor is frequently mistaken for the pigmentary stains of the erythematous and other syphilides. In the parasitic eruption the patches are very large and also very small, whereas in the syphilitic pigmentation there is greater uniformity of small patches. Pityriasis or tinea versicolor begins about the sternal region, and from there spreads over the trunk, quite rarely to the extremities, neck, and most rarely to the face. It is also at times pruritic. Its patches may be removed by brisk friction, and its scales under the microscope show the microsporon furfur.

The rings of this syphilide are permanent and show no tendency to increase, and the enclosed skin is unaffected, while those of tinea tonsurans enlarge gradually, enclose areas of scaling, slightly brownish skin, and are more scaly. In the scales of the parasitic eruption the tricophyton tonsurans is found.

ERYTHEMA OF MUCOUS MEMBRANES; MUCOUS PATCHES AND CONDYLOMATA LATA.

The mucous membranes are involved during the whole course of syphilis, particularly in its earliest period, by several morbid changes similar to those of the skin—namely, the erythema and the cell-infiltrations. The eruptions thus produced have points of resemblance with those of the skin, but they are much modified by moisture, friction, and irritations to which mucous membranes are constantly subjected.

The first and most constant erythema is that of the fauces or uvula and roof of the mouth. It may consist of simple redness of the surface, without any thickening, or of a redness with œdema of the parts. A more advanced form is that in which, in addition to the erythema, the surface of the mucous membrane has a milky appearance, as if lightly touched with a mild solution of nitrate of silver or carbolic acid. This opaline condition in syphilis is not developed in an unbroken patch, but scattered all over these surfaces are patches of superficial erosion of various shapes. This opaline erythema may be limited to the posterior wall of the pharynx, and may also involve the tonsils and just fringe the borders of the pharynx. It also extends to the soft palate and the roof of the mouth, on either one or both sides, and it is there absolutely diagnostic of syphilis, since in no other disease do we find the peculiar

which surround them and by treatment, to which they, like well-developed mucous patches, are slowly amenable. When much neglected on the penis and vulva, they in time form large, firm, exuberant, cauliflower-looking masses, which have nothing of a syphilitic physiognomy, and are commonly mistaken for enormous vegetations, which in strict truth they are. Under these circumstances they are liable to undergo cancerous degeneration.

Upon whatever part situated—about the mouth, nose, eye, anus, penis, and vulva—mucous patches and condylomata lata more or less seriously interfere with the functions of the part. They are often accompanied by engorgement of the ganglia in immediate connection with the region upon which they are developed.

The **treatment** of these lesions will be given with that of the syphilides.

THE PAPULAR SYPHILIDES.

Papular syphilides are formed by circumscribed cell-infiltrations into the papillæ and rete mucosum. There are two well-defined varieties—the *conical* or *miliary*, and the *lenticular* or *flat*.

The *miliary papular syphilide* is divided into two varieties—the small and the large. The small papules may be of the size of a pin's head, and even three or four times as large. They are conical or rounded, sometimes slightly umbilicated, elevations of the skin of a deep pinkish-red or of a dull coppery-red color. They present the marked peculiarity of appearing in groups or in the form of circles and segments of circles or shaped like the letter S. The arrangement of the eruption, as a rule, differs somewhat according to the time of its development. When it appears very early it is copiously scattered over the body, and particularly on the face, with considerable interpapillary hyperæmia. A later evolution is peculiar in the fact that the circular and grouped tendency is more pronounced, so that even to the later months of the secondary period we see this syphilide in these forms generally much less copiously than earlier, and localized in certain regions.

The small miliary papular syphilide usually begins about the face, and from there invades the whole body. Its evolution, particularly when early, is, as a rule, quite prompt, in some instances so much so that it may be called acute. Later on it may be slow, even chronic, in appearing, and there often is not the uniformity of size of small papules, but an intermixture of some large ones. The morbid process composing this syphilide is really a specific folliculitis; in other words, the lesions consist of infiltrations around sebaceous and hair-follicles. Such is the usual density of the papule tissue that the syphilide is peculiarly chronic and persistent, remaining unchanged, except perhaps showing a slight desquamation, for long periods. When large surfaces are invaded by this syphilide, passage of the hand over them gives a rough sensation, something like that of a nutmeg-grater or of sand-paper. Being essentially a follicular lesion, it is seen in copious development about the face and back, upon the anterior surface of the thorax, and on the outer aspects of the legs and arms. On the face and sternal region, in cases where the papules are very numerous and closely packed, they often run together into patches and become covered with thin, adhesive, sometime

Mercurial treatment will cause the specific lesions to disappear, and fails to affect the simple ones.

THE LENTICULAR OR FLAT PAPULAR SYPHILIDES.

There are two varieties of this syphilide—the *small* and the *large*. The small papular syphilide very commonly appears as a general eruption, sometimes being the first secondary manifestation upon the skin. The large papules are rarely seen as the first general eruption, most commonly occurring in sparse and scattered form with the erythematous syphilides or with the small papular variety, or even with the pustular syphilides. It is also seen as a rather late general rash.

The *small flat papular syphilides* begin as rosy-red spots which reach a diameter of one-eighth to one-fourth of an inch and an elevation of from one-third to one-half a line. They are of round or oval shape, sharply marginated, surrounded with a slight red areola, and of a flat, rounded, and sometimes umbilicated surface. They never show any anatomical connection with the follicles, but about the thorax often follow the line of obliquity of the ribs. The early general eruptions are, like those of the erythematous syphilide, scattered symmetrically over the body, and the papules show no tendency to fuse together. In relapses, which are not uncommon with this syphilide, the papules are less numerous, are prone to appear symmetrically on certain regions, and also to assume a circular form.

The sites upon which the papules first appear are about the shoulders, along the sides of the thorax, about the back of the neck, on the forehead, along the margin of the hairy scalp, where they form what has been called the corona Veneris, and upon the face, particularly in the central portions about the nose and mouth. Commonly, the extremities are invaded after the trunk and the head, and in early exanthems on both surfaces, flexor and extensor. In very many cases the supra- and infraclavicular regions are spared, but the rest of the trunk is well covered. The papules also appear on the palms and soles, less copiously on the dorsum of the hands and feet. On the gluteal regions they are usually very numerous, and they are also found on the mons Veneris and groins. In somewhat rare cases these papules appear in great profusion about the face, often attended with marked hyperæmia, when they cause a peculiar leonine expression that has been fancifully called syphilitic leontiasis—a condition which is also produced in even a more marked degree by later tubercular eruptions.

The color of these syphilitic papules is subject to much variation in consequence of their situation and the conditions of the patient's circulation. Being at first of a rosy or pinkish red, they gradually become darker and have a coppery tint. This deepening of color comes on earlier, and is usually more pronounced upon the face, the forehead especially, and the legs. It is not uncommon to see the papules remain unchanged for a few weeks on the trunk. Very often they can scarcely be said to have any characteristic color, but look like pale yellowish elevations of cell-infiltration, without hyperæmia, particularly in persons of very thin skin and poor circulation. On the legs they often take on a purplish color, and become surrounded by a well-marked areola of the same tint,

or they may be sparsely grouped in the central hollow, with a few scattered outlying ones, or they may show a tendency to the formation of more or less complete circles. In these regions and upon the soles of

FIG. 199.

Scaling syphilide of the palm.

the feet these papules are prone to become seated in a chronic form, when they lose all individuality and give rise to a patchy or expansive scaling and thickening affection of the skin. Fig. 199 shows very clearly the sparse distribution of the scaling patches of the palm following the flat papular syphilide, in marked contrast to the appearance of psoriasis and eczema of these parts.

The resolution of this syphilide in its uncomplicated form is accomplished by the absorption of the new cells, which is always materially hastened by the action of mercury. The papules gradually subside and flatten until pigment-spots, red or coppery in hue, are left. The pigmentation disappears gradually, and remains longest on the lower extremities.

In most cases atrophic changes do not follow the flat syphilitic papules, though when they are very chronic, especially about the face, small spots of atrophy are left.

The mode of invasion of this syphilide is usually subacute, and is often accelerated by excessive heat, alcoholic drinks, and hot baths. A period of a week or two, and sometimes longer, is required for its full evolution. The copiousness of the eruption is very variable, being well marked in first rashes, even to the point of nearly covering the whole surface of the body, while in relapses it is more or less sparse. In the latter forms new papules may appear for one or two months.

Relapses may be expected at any time within two years after infection if treatment is not followed, and sometimes later.

The concomitant lesions and symptoms of this syphilide, when it is the first rash, are mucous patches and condylomata lata of the mouth, throat, genitals, and anus, general adenopathy, alopecia, cephalalgia, neuralgias, rheumatoid pains, and iritis.

Diagnosis.—Such are the marked appearances of this syphilide as a general eruption, with its history and concomitant symptoms, that the diagnosis is usually very easily made. When, however, it exists in a sparse and localized form, particularly when the papules are of varying sizes and more or less scaly, a semblance to psoriasis is offered. The papules and patches of this latter affection are essentially scaly, silvery, and imbricated. It usually begins before puberty, and its history is that of a repetition of precisely similar lesions, and sometimes of heredity. In syphilis the history of some or all of the primary or secondary lesions and symptoms may usually be obtained, and the fact may be elicited that previous eruptions presented different peculiarities. In syphilis repetition of precisely the same dermal lesions is not common. In the ringed form of the small flat papular syphilide its tendency to be localized near joints, its history, and the coincident appearance of lesions of the mucous membrane will generally point to its origin.

The Large Flat Papular Syphilide.—The large flat syphilitic papules are exaggerations of the smaller ones, being from a quarter to a half inch, and even an inch, in diameter. They are round or oval, sharply marginated, having a flat surface, with sometimes a sloping depression in the centre. They appear as minute spots, which increase in area and in height, the latter being usually about one line or less. They vary in color, being of a rosy-red, a sombre coppery-red, and even of a purplish-brown color.

This syphilide rather rarely appears as the first secondary eruption, and is then very often mingled with the erythematous syphilide, with which it sometimes appears in limited numbers. It is usually a much more sparse eruption than the small flat variety, and does not show the tendency of the latter to become grouped in the form of circles. It is found on the forehead, face, nucha, shoulders, back, anterior portion of trunk, over the inguinal and gluteal regions, and over the extremities on the flexor aspects, and particularly near joints. It is found on the palms and soles, and near and on muco-cutaneous junctions, where it is prone to assume the appearance of condylomata lata. Friction or irritation causes these papules to increase very much in area.

This syphilide belongs to the middle and late portions of the secondary stage, rather than the early ones, and for this reason it is called by the French an intermediary eruption. It may occur quite late in syphilis, even in the third year, and is seen to coexist with well-marked tertiary lesions. It may relapse several times, but commonly this occurs in the progressively sparse forms, so that there may be less than a dozen of these lesions on the whole body. When they thus appear very late they often attain an area of more than an inch in diameter, with a corresponding deep-seated condition and marked elevation, when they reach the dignity of being called papulo-tubercles. These large papules undergo metamorphoses similar to those of the small ones. Their sur-

faces may become covered with a dirty false membrane; they may be the seat of ulceration; they may form scaling patches, and by peripheral extension form distinct rings. In rare cases they grow in area, while from their surfaces papillomatous growths, due to inflammatory hypertrophy of the papillæ, shoot up and form what has been called the verrucous or vegetating syphilides. This phenomenon is mostly observed upon the scalp, face, shoulders, gluteal regions, and genitals. The papules sometimes reach an elevation of two or three lines, and even more, and give issue to a foul-smelling secretion. This transformation is also seen in condylomata lata, in syphilitic tubercles, and upon the surfaces of healing gummatous or tubercular syphilitic ulcers.

When near parts the seat of moisture or in coaptation the papules become superficially eroded.

The tendency of the large flat papular syphilide is to remain in an indolent condition and to present chronic scaling or ulcerated surfaces. Under treatment the papules slowly subside, accompanied by more or less desquamation, until pigmented spots are left. Sometimes the centre of the papule is absorbed first, and a scaling ring is left for a short time.

The concomitants of this syphilide when it appears early are those of the exanthematic stage. Later on it may coexist with pustular eruptions of the hairy parts, iritis, nodes of flat and long bones, alopecia, onychia, perionychia, condylomata, and cachexia, and, when very late, with tertiary lesions.

Prognosis.—The early appearance of this syphilide is indicative of an active and proliferative state of the disease. Its frequent relapse is an undoubted proof of the gravity of the case.

Diagnosis.—This form of syphilide is usually very readily diagnosticated when it appears early and coincidently with other syphilitic symptoms. Later on it may be mistaken for psoriasis, particularly if the patches are scaly. A consideration of the facts given in the diagnosis of the small flat papular syphilides will be of service in determining the nature of the larger papules.

SYPHILITIC ONYCHIA AND PERIÓNYCHIA.

In syphilitic onychia the morbid process begins in the nail itself; in perionychia it begins in the soft tissues around the nail, and then involves it. Both affections run a chronic course and are more or less destructive. They are peculiar to the first and second years of syphilis, but may occur at later periods.

In syphilitic onychia the nail becomes lustreless, of a dull-yellow or bluish-yellow color, thickened, cracked at the free margin, friable, and brittle. Its surface becomes rough and seamed with longitudinal fissures, which allow dirt to accumulate. The surrounding skin becomes thickened, cracked, and scaling. More or less of the nail is thus involved.

In the early secondary stage separation of the nail to a greater or less extent may begin at the free border and extend toward the base. In some cases this morbid process consists of a narrow linear separation; in others more or all of the nail becomes separated. As this detachment occurs the color of the nail changes into a greenish-brown or bluish-black tint. When the separation is partial the newly-growing nail from the

base pushes forward and covers the part left bare. One or more nails, even all of them, may thus be affected, those of the hands more commonly than those of the feet.

Perionychia syphilitica is seen in two forms: first, that in which the lesion begins around the margin of the nail; second, where the integument of the distal phalanx becomes infiltrated and inflamed, and as a result the nail is secondarily involved.

The affection usually begins as a papule or pustule, or as a fissure, which is initiated on either the lateral borders of the nail or at the basal sulcus. Ulceration then begins, which affects the nutrition of the nail and loosens it. If this process is limited to one border or to a portion of the border of the nail, and is arrested early only a limited destruction is produced. If, however, the morbid process begins at the basal sulcus, the ulceration burrows under the lunula, and then may involve the whole matrix. In this case the nail is wholly destroyed, whereas if the ulceration begins on the side, and even involves considerable surface, the nail will be soon replaced, since the base and lunula then remain intact.

If the base of the nail is wholly destroyed by ulceration, a new one is not formed, and the matrix becomes covered with cicatricial tissue. When the distal part of the matrix has been fully destroyed, the nail reaches as far as that, and there stops.

Ulcerative perionychia may begin under the free margin of the nail and gradually destroy the matrix as far as the base.

Diffuse perionychia usually begins painlessly during the active stages of syphilis as a redness of the distal portions of the fingers. The affected portions gradually become of a sombre coppery red and swollen and

FIG. 200.

Diffuse syphilitic perionychia.

bulbous, sometimes in shape like an Indian club. When the inflammation and infiltration are advanced, the nutrition of the nails is affected, and they die rapidly as if struck by a blight. (See Fig. 200.) This

rapid necrosis is peculiar to this form of perionychia. The nail first loses its color, which becomes dull and dark; its lateral attachments become loosened, its whole surface is undermined and ulcerated, and a foul-smelling pus escapes from beneath it. Then the nail becomes blackish-green, uneven, and puckered. With the onset of the nail-affection severe pain begins, which renders the fingers useless and the toes an impediment to locomotion. If any portion of the nail remains imbedded—and some usually does—it acts as a foreign body and keeps up the pain and ulceration. In these cases inflammation of the lymphatics and axillary glands, with fever, malaise, and much suffering, may supervene. When the dead nail is removed and treatment instituted, the swelling begins to subside and the matrix to heal, and unless the destruction has been too great, a new nail, at first rather imperfect, is formed.

In the **treatment** of these nail-affections internal medication is of prime importance, while local applications are also required. For the dry onychia careful trimming and filing are necessary, with the prevention of irritation. For the ulcerative form careful washings with antiseptic solutions, and the application, if necessary, of a mild caustic, followed by iodoform, are essential.

For diffuse perionychia the first indication is the total removal of the nail and its spiculæ. When much inflammation is present hot-water immersions, followed by the application of lead-and-opium wash, are required. Then iodoform may be carefully dusted over the morbid surface, which may be covered with absorbent cotton and the finger gently bandaged. Equal parts of mercurial and zinc ointments, with extract of belladonna, may be used in addition.

THE PUSTULAR SYPHILIDES.

These eruptions are less common than the preceding ones, and may appear both early and late in the course of syphilis, in a mild and ephemeral and in a severe form.

In size the pustules may be as small as a pin's head or as large as a ten-cent piece. They are conical, globose, flat, sometimes umbilicated, of round or oval outline, and usually surrounded with more or less bright-red or copper-colored areola. Under some pustules there is considerable cell-infiltration; under others the thickening is not very perceptible. These lesions begin as true pustules or as papules which shortly become pustules. The pustular syphilides may become copious and involve the whole body, or be less copiously though generally distributed. Again, they may be sparse and limited to certain regions. Regions copiously supplied with hair and sebaceous follicles are the ones most commonly invaded by these eruptions. The pustules are usually symmetrically distributed either in a grouped or scattered form. The early and extensive eruptions of these syphilides appear and develop promptly, the latter and more sparse ones in a subacute and chronic manner.

In general the pus of these lesions dries quickly into crusts, which vary in shape according to that of the pustules. They may be conical or flat, round, oval, or horseshoe-shaped.

Pustules may simply leave pigmentations or even cicatrices.

THE SMALL PUSTULAR OR ACNEFORM SYPHILIDE.—This *syphilide*

and more sparse eruptions may be mistaken for acne. The latter simple affection begins about puberty on the face, and later on the back, never in the scalp; consists of papules, pustules, and comedones, and is lacking in a syphilitic history and other specific symptoms and lesions.

THE LARGE PUSTULAR OR IMPETIGO-FORM SYPHILIDE.—This syphilide is less common than the preceding variety, and consists of pustules of the size of a pea, and even of greater area. The eruption resembles simple impetigo somewhat in the appearance of the pustules, in their grouping, in their tendency to coalesce, and in their crusting. In general, however, the syphilitic pustules are larger and flatter than those of impetigo; hence the resemblance is often more imaginary than real.

This eruption may be said never to occur as the initial secondary rash, but it usually follows the early ones at longer or shorter intervals from the middle of the first and as late as the second or third year. Like all the early syphilides, the eruption of this form is more copious in the early months, and more sparse and localized at later periods. The pustules have a perifollicular origin in most instances; hence the syphilide is most constant and exuberant on parts where the sebaceous and hair-follicles are most numerous.

The pustules begin as red spots which rapidly become elevated by yellow subepidermal pus. They are in shape round or oval, decidedly elevated, acuminate, globose, and sometimes distinctly umbilicated, particularly as they begin to desiccate. Over bony prominences and parts subject to pressure and friction they increase much in area.

After the maturity of the pustules they promptly begin to wither, and soon flatten down into light or dull-greenish or brownish-green and brown crusts, and, as they then increase more or less in area, those which are near one another may fuse together. They thus occur in irregular and round groups; sometimes the outer ones fuse and form circles enclosing an encrusted or red area of skin.

In many cases this syphilide becomes encrusted. The ulceration under the crusts is usually superficial and not active. In unhealthy subjects the pustules become active ulcers, which increase peripherally while they heal in the centre. They thus increase in a serpiginous and superficial manner, until they may cover large portions of the integument. In some cases a deeper serpiginous ulceration takes place. Thus it is that this syphilide is one of the foci of the two forms of *serpiginous syphilide*. The ulcerations may extend in depth rather than in area, and destroy much tissue, as is sometimes seen on the scalp (where they may become vegetating), in the beard, and upon the nose. In cachetic, dissipated, and poorly-nourished subjects this syphilide in its entirety is prone to undergo exacerbations, by which, owing to the extent and depth of the many ulcers and to the concomitant systemic condition, a malignant form of syphilis is developed.

The course of this syphilide is generally chronic, and rather exceptionally rapid. It may appear as a quite copious eruption, and thus end, or it may begin in a generalized sparse form, and from time to time be increased by the appearance of new pustules.

This syphilide is rarely found in combination with the erythematous syphilide, except as a relapse, but in a sparse form it is sometimes a con-

greenish-brown, and even black, crusts from the admixture of dirt or the presence of small quantities of blood. The process of extension is attended with a flattening and perhaps central depression in the crusts. This syphilide is usually attended with a well-marked, pink-red and dark-red areola, but it is less active, inflammatory, and pronounced than it is in simple ecthyma. Beginning as a purplish-red, it soon reaches the deep coppery-red hue. (See Plate IX.)

The superficial ecthyma-form syphilide begins in a more or less sparse form about the face and neck, particularly near the margin of the hair, and from there it spreads most copiously over the back, legs, or on the anterior surface of the trunk, on the gluteal and inguinal regions, and on the outer aspects of the arms and legs, usually being more profuse on the upper than on the lower extremities. The whole eruption may appear promptly within a week or ten days, and perhaps be attended with fever and malaise, or it may be developed in crops at short intervals, the whole evolution sometimes occupying several months. As a rule, the earlier the appearance of the eruption the more copious and extensive will it be, and *vice versa*. The pustules may be scattered in an isolated manner or grouped together, sometimes in the shape of circles and parts of circles. In late appearances this syphilide may be unsymmetrical and limited to one or more regions. One peculiarity of this syphilide is, in some cases, to form into kidney-shaped crusts.

The deep variety of the ecthyma-form syphilide is simply an exaggeration in all respects of the preceding. (See Fig. 201.) The pustules begin on a more infiltrated base, ulceration is more extensive and deeper, and the crusts become firmer and thicker and very rapidly of a brownish-black color. When lifted off, usually requiring some little force, a grayish-red ulcerated surface covered with an unhealthy glutinous pus is seen. The surrounding areola is of a deep coppery red. The situations of development of this variety are similar to those of the superficial form. The lesions are, as a rule, less numerous, more localized, and even more chronic. They may remain isolated or several may coalesce.

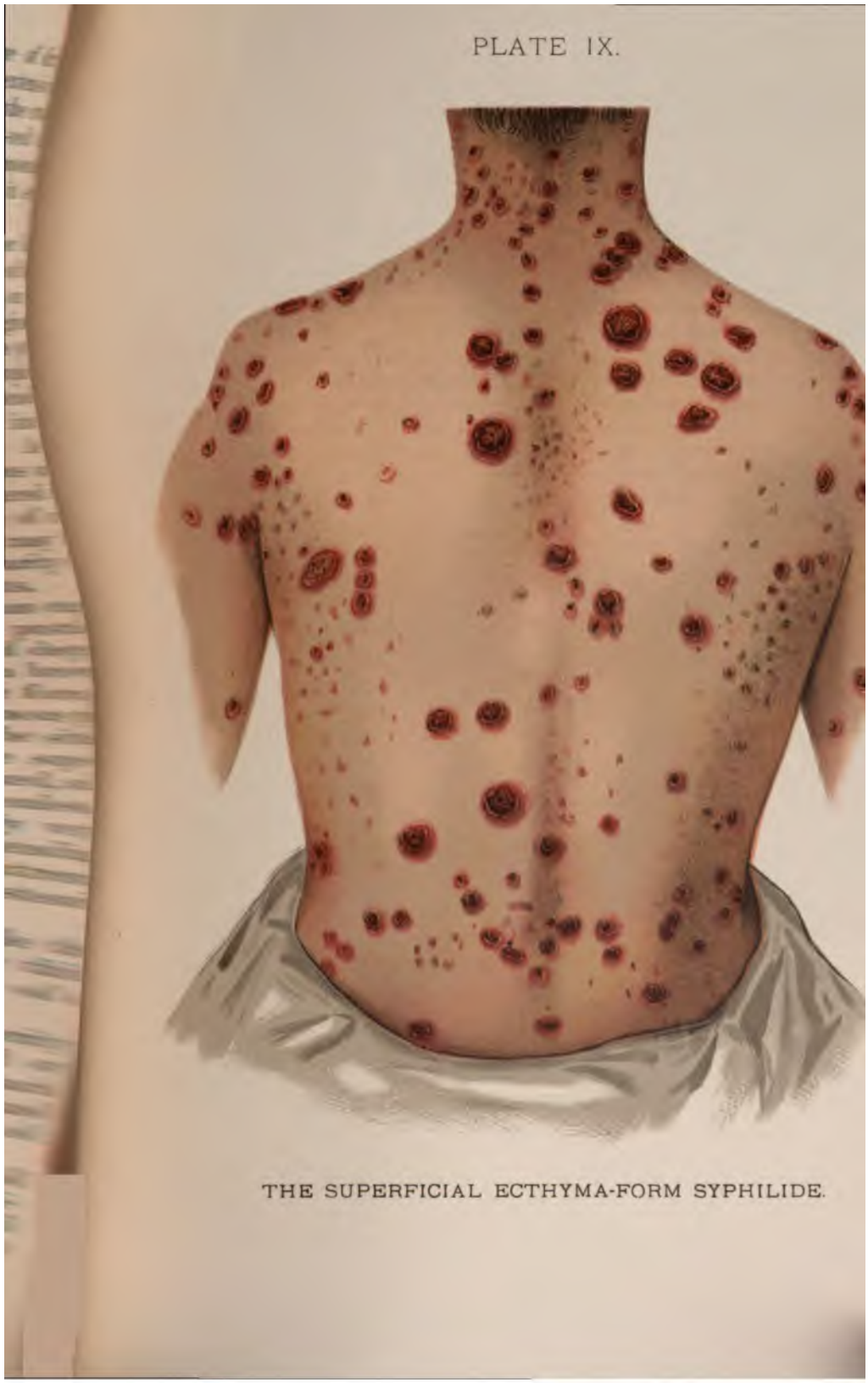
The evolution of the deep ecthyma-form syphilide is usually very slow, appearing in crops of from two to a dozen pustules, and extending over months or a year. In some cases it is accompanied by extreme cachexia and fever of a remittent type, while in others the systemic symptoms are not severe.

The superficial eruption generally leaves pigmented spots, while the deep variety very often is followed by well-marked and commonly thin cicatrices, which are at first of a coppery color, and in time become of a glistening white.

The **prognosis** of this syphilide depends largely upon the severity of the systemic condition, which, as has been shown, may be mild or severe. The presence of so many encrusted lesions gives rise to much discomfort, and at last they leave temporary spots of disfigurement and even indelible cicatrices. The persistent appearance of new crops of pustules influences the prognosis unfavorably.

The **diagnosis** of this syphilide is usually not difficult. It is well to bear in mind that the subacute aphlegmasic evolution of the syphilitic eruptions is in marked contrast with the inflammatory course and pruritic condition of simple ecthyma. The latter is, as a rule, seen most

PLATE IX.



THE SUPERFICIAL ECTHYMA-FORM SYPHILIDE.

This eruption is prone to appear upon the face, on the outer and inner surfaces of the extremities, and upon the trunk, particularly upon the back. The crusts are most frequently seen on the forehead, near the nose, mouth, and on the chin. In other cases the forearms, and even the trunk, may be affected, and sometimes all of the regions previously mentioned may be the seat of rupia. It is rare to see the eruption limited to the lower extremities. While in general rupial crusts retain their own individuality, they sometimes coalesce and form horseshoe and other irregular shapes.

The mode of evolution of the syphilide is usually by successive crops, which may appear on a certain region or may extend to other parts. This eruption usually leaves cicatrices of various degrees.

The *large form of rupia* is usually quite sharply limited in its area of development, as well as in the number of its lesions, and its course is more chronic and more aphlegmasic than that of the small variety. It occurs most constantly upon the face, on the scalp, trunk, and upper extremities, also upon the buttocks and lower extremities. It may be symmetrically or unsymmetrically distributed, and may be limited to one encrusted ulcer or there may be as many as twenty or thirty. The lesions usually appear singly or in small number, and they grow slowly and painlessly. Their course is markedly irregular, some being developed with comparative rapidity and reaching an area of one inch within one or two months, while in the evolution of others six or more months may elapse. Having reached a diameter of about an inch, further increase is usually accomplished quite slowly.

The ulceration, which is really the essential lesion in the large form of rupia, is usually quite deep, involving one half and even more of the thickness of the derma, and has a smooth, unhealthy, grayish-red surface, with a sharp, undermined margin of a deep-red color.

After removal of these crusts thinner ones may form until treatment produces healthy granulation and healing. Not very infrequently, even in untreated cases, healing begins spontaneously under the crust, which may be thrown off by the profuse granulations. The latter feature may occur even in cases while under treatment. Upon the healing of the ulcer a deep-red, thickened, glazed spot is left, which slowly becomes thinner, sinks down more or less below the skin level, becomes slowly blanched, until in the end, which may occupy weeks, months, or years, a white, shining, depressed citatrix surrounded by a pigmented border, and perhaps traversed by fibrous bands or the seat of minute follicular depressions, is left.

The **prognosis** of rupia should be guardedly made, since the systemic condition is usually that of more or less pronounced cachexia. Coexistence of visceral affections renders it more grave. Early precocious and extensive eruptions call for careful hygiene and treatment. Such cases are not necessarily fatal, nor are they always indicative of permanent ill-health or invalidism, since they are amenable to judicious and energetic medication, local and general.

The large form of rupia is usually indicative of a profound and lasting infection and greatly impaired nutrition, and calls for the most watchful and judicious treatment.

There are three distinct varieties of the early or precocious gummata —a generalized, a localized, and a neurotic variety.

The *generalized form* appears as early as the eighth week of infection and at any time during the first and early parts of the second year, the rule being that the earlier the date of its appearance the more extensive is the eruption and the more numerous the lesions. It begins in the form of small circumscribed swellings under the skin, usually unattended with pain and only perceptible to the touch. In a short time they become adherent to the skin, and then they appear like bright-red spots, which are frequently looked upon as blind boils. Thus early they are found to be round or oval tumors of the size of a bean deeply set in the skin. They grow quite rapidly, and within ten days may attain an area of an inch or an inch and a half. A slower growth is also seen. As they increase in size their red color becomes more sombre and perhaps coppery. When fully developed they present a quite firm structure, and may be said to be in the stage of condensation. Their course is usually quite constant and without much variation. As they grow older their red color becomes more coppery, and they gradually grow softer in structure, as if they were permeated with fluid. This may be called the stage of softening, which varies in degree in different cases. In some tumors there is simply a soft, yielding condition of the tissues; in others what appears to be true fluctuation may be left. To the inexperienced these tumors in the latter case may give the impression of abscesses and suggest the use of a knife, which, however, should not be used, since absorption may occur even in this stage of liquefaction of the gummy infiltration. Under favorable circumstances these lesions do not go on to ulceration, and they are then said to belong to the resolutive variety of this early form of gummata. Then the tumors gradually lose the slight convex elevation which they had attained, and slowly flatten out, while they gradually melt away from their outer edge, their color fading *pari passu* until a pigment-spot is left which is most persistent upon the legs. Slight or severe cicatrices may also be left. The period of development of these tumors usually occupies from ten days to two weeks, but after that their duration is variable. Under careful treatment they may promptly retrogress, and may without it remain in an indolent condition in the second stage indefinitely.

This eruption is prone to appear symmetrically over the body, at first in a crop of goodly number, which may be increased by successive smaller ones at shorter or longer intervals. Sometimes, even when the general eruption is copious, medication is very efficient in the control of this syphilide, and new crops may be prevented if treatment is instituted promptly. The arms, forearms, the scapular regions, perhaps the back, the anterior surface of the trunk, the gluteal regions, thighs, and legs, mostly on the anterior and outer aspects, are the parts usually invaded. On the legs these tumors frequently take on inflammatory action when complicated with varicose veins, with œdema, chronic eczema, dermatitis, erysipelas, and pediculosis.

In some cases the resolutive tendency in this eruption is not observed, but a necrobiotic action soon appears. The stage of condensation is then quite short and softening begins early. The centre of the tumors assumes a dark-red color in one or in several spots, and distinct fluctua-

addition to the neuralgic phenomena, local pains on the sites of the lesions or on the whole territory or limb on which they are developed are complained of. These pains may be continuous or intermittent, and in some instances are as excruciating as in severe herpes zoster. They are described as flashing, burning, lancinating, and are sometimes said to resemble those of an abscess. In some instances the patient's sufferings are less after the evolution of the syphilide, but in most cases the tumors are so painful that patients shrink with terror from their palpation. There is also a moderate febrile movement, an evening temperature of 100° F., and in very severe cases as high as 104°; emaciation, want of appetite, and all their concomitant symptoms. The seats of predilection are the forearms and legs, but the tumors may appear on the shoulders, arms, thighs, chest, and trunk. As a result of the pain and swelling in the arms and legs there is more or less discomfort, stiffness, impairment of motion, even to the extent of pseudo-paralysis.

The eruption consists of two orders of lesions: first, oval or round tumors, or irregular plaques from fusion of tumors; second, tumors or nodosities seated in the subcutaneous tissues, and at first freely movable under the skin and fasciæ, and later on adherent by both their upper and lower surfaces.

The cutaneous tumors begin by infiltration in the deeper portions of the skin and its contiguous connective tissue. When first seen they are in bright-red and rather sharply circumscribed spots, which soon form round or oval swellings slightly raised and convex. In some cases the bright-red color rapidly becomes darkened until a blackish-red or decidedly ecchymotic appearance is seen, while in others it is of a deep bright-red similar to that of erythema nodosum. In some cases, again, the red centre pales and becomes the color of white wax or of a billiard ball, while the deep-red border or areola remains in various stages of intensity, consisting of a commingling or play of colors, such as we see following a bruise or erythema nodosum. In many cases resolution takes place; in others the stage of softening may end in ulceration. The resulting ulcers present all the characters of the late gummata, except that they are rather more superficial. Their subsequent course is usually chronic and aphlegmasic. In some cases general inflammation and swelling attack a limb or the seat of these lesions, and the patient's suffering is thereby much increased. Commonly, these tumors or ulcers remain separate, but sometimes they increase and coalesce. They are, as a rule, symmetrically placed. The resulting cicatrices are usually slight and superficial.

Late or *tertiary gummata* are peculiar to more advanced stages of syphilis, and are, like the preceding lesions, true circumscribed tumors. This eruption is generally composed of a limited number of lesions whose invasion is slow, painless, and aphlegmasic, and which are symmetrically or unsymmetrically placed. It is particularly prone to appear upon parts where the connective tissues are loose and abundant. It may be limited to the connective tissue, and on invading the skin it usually ulcerates. When subcutaneous the lesions are called *gummous* or *gummatous tumors*, and when they involve the skin in ulceration they are called *gummatous ulcers*. This syphilide, therefore, has three stages—of tumefaction, of ulceration, and of repair. It begins as small, pea

sized, movable, painless nodules under the skin, which grow quite slowly. As they increase in area they contract adhesions with the skin, and over bony surfaces and in parts where the connective tissue is scanty, with the periosteum and fasciæ. They possess a well-marked firmness of structure, are quite resistant to pressure, less elastic than fatty tumors, and not as firm as scirrhus. The superficial growth of these nodules is attended with reddening of the skin, which, as infiltration goes on, becomes of a deep copper-red, much thickened and less supple. The resulting lesions are tubercular infiltrations into the skin and connective tissue, or true gummy tumors, which are more or less convex and usually surrounded by an inflammatory areola of greater or less breadth. Gummy tumors may be of the size of a pea, a hickory-nut, or have a diameter of several inches. They show a marked tendency to develop in groups near together, and while each may remain isolated, they frequently fuse together into large patches.

Gummy tumors may remain in the stage of tumefaction for weeks or months, and under treatment undergo resolution. As a rule, however, they soon undergo degeneration in either of two ways: ulceration may occur at one or more points on the cutaneous surface and extend to the whole lesion, or the subcutaneous new growth may soften and cause ulceration in the overlying skin. Various stages of fluctuation are felt in these softening tumors. In many instances the symptom is deceptive, and a premature incision gives vent to a thick, bloody fluid and reveals a softened necrotic mass. True fluctuation, however, may be felt later on, and a cavity containing a thick, viscid, gummy fluid, resulting from the disintegration of the tumor, is found. Surgical interference is not usually required.

The resulting gummatous lesion is in shape similar to the tumor, round or oval or horseshoe-shaped, gyrate, or irregular, from the fusion together of these lesions. (See Fig. 202.)

FIG. 202.

Late gummatous infiltration and ulceration.

The floor of gummatous ulcers is very uneven, of a reddish-green, sometimes greenish-black, color, and bathed with a sanious, very fetid

pus. The edges are thickened, sharply cut, and perpendicular, as if punched out, red, sometimes more or less everted, and surrounded by an extensive areola of hyperæmia. The course of these ulcers varies according to the care they receive. They often remain in an indolent condition for months, and cause much œdema of the surrounding parts. Groups of ulcers may be found connected by narrow bands of reddened and detached skin, whose nutrition is but feebly sustained by the superficial vessels.

The depth of these ulcers depends largely upon the thickness of the connective tissue and the extent of the infiltration. Over bony surfaces, such as the ulnæ, clavicles, cranial bones, and the anterior surfaces of the tibiæ, they are comparatively shallow, as they are near joints. Upon the walls of the body, arms and thighs, and more especially upon the gluteal regions, they are often very deep, in very fat persons in these localities being fully three inches below the skin-level. In some cases they expose the surface of muscles, and they may even invade the intermuscular septa.

Reparative action is seen in the development of healthy granulations upon the foul surface of the ulcer, in the cicatrization, beginning usually at the margin, and in the fading of the hyperæmic areola. The cicatrices differ according to the situation and depth of the destructive process. In some cases they are thin and parchment-like; in others they are rough from the presence of fibrous bands and nodules. Their deep purplish-red or coppery-red color gradually and very slowly fades from their centre outward until a dead-white, and perhaps glistening, hue is left.

The gummatous syphilide may appear on the scalp, the face, and the neck. It is prone to attack the extremities near the joints, and is found on the posterior aspect of the trunk more frequently than on the anterior, very often on the gluteal regions, very rarely on the lower part of the abdomen, and never on the palms or the soles.

The ulcers may take on a serpiginous course, and may become converted into the serpiginous syphilide; they may become phagedenic or even gangrenous. They may be complicated by erysipelas, particularly when seated on the head or the extremities, and their healing thereby is often much accelerated. They frequently induce upon the legs severe chronic œdema, which may give rise to a condition similar to elephantiasis Arabum.

Gummy tumors and ulcers, when seated on the upper and lower extremities, sometimes involve the cutaneous nerves and cause neuralgias and various other disturbances of sensibility.

Prognosis.—The appearance of gummata very early in the secondary stage is indicative of an active condition of infection and a lowered vitality, and calls for prompt and efficient treatment.

Tertiary gummatous lesions show that the diathesis is still active and that infiltrations in various portions of the body are to be feared. Besides the local danger incident to these lesions, the general systemic condition is usually not favorable. The presence of a gummy infiltration into any part points to the necessity of thorough and prolonged treatment.

Diagnosis.—The early generalized form of gummata is usually

tubercles" to lesions which are more than papules and less in structure than tubercles. While the papular syphilides, though peculiar to the secondary period, may appear rather late in the disease, so the tubercular syphilides, though belonging to the tertiary period, may exceptionally be developed more or less early in the secondary stage.

The non-ulcerative or resolutive tubercular syphilide is seen in two well-marked forms: first, as sharply-defined conical or rounded tubercles; and second, as more or less elevated, flat, sharply-circumscribed, and often scaly patches. These lesions do not, as a rule, ulcerate, but disappear by fatty degeneration and interstitial absorption.

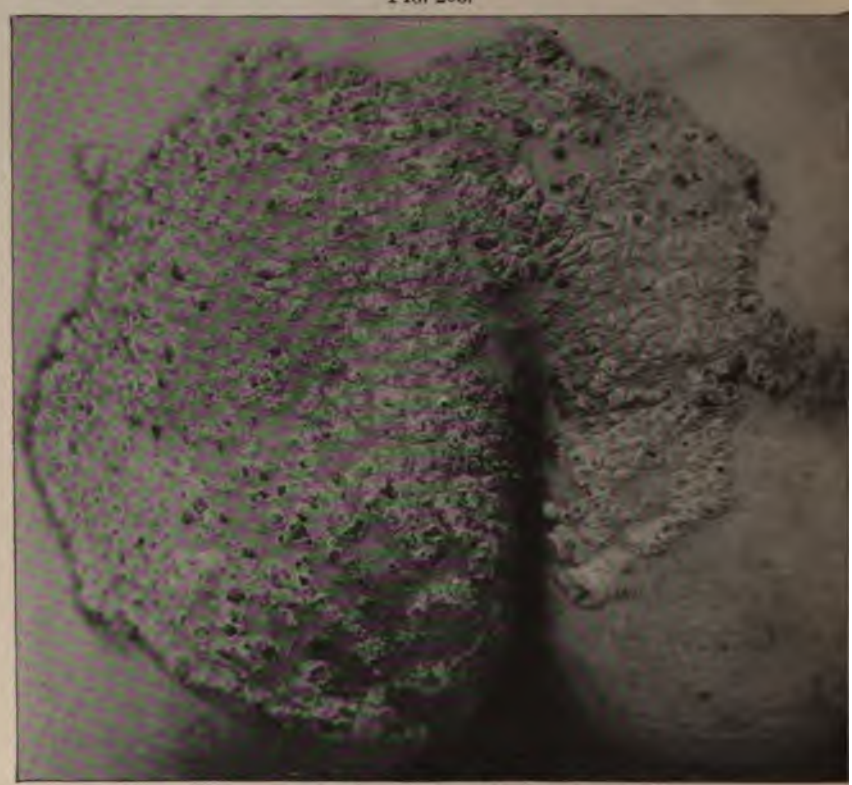
The conical or rounded tubercles vary in size from a diameter of one-third of an inch to an inch or more. The small ones are comparable to a split pea seated deeply in the derma, while the larger ones may be likened to a split marble and a split walnut similarly placed. These lesions begin as pinkish and even deep-red, non-inflammatory spots, which increase slowly in depth and area until a decidedly rounded or conical elevation is reached, when the sharply-defined tubercle is the result. The small tubercles retain their rounded or conical elevated state for considerable periods, while the larger ones become flatter and seemingly, but not actually, less salient. When fully formed they have a pinkish-red, a coppery or brownish-red, and even a crimson-red, color.

When appearing in the secondary period—or, as we may say, precociously—this syphilide usually invades the whole body in the same symmetrical manner as the large papular syphilide, in a more or less copious and disseminated eruption. In its normal evolution it shows a tendency to attack certain regions, perhaps being limited to one or invading several. The sites of predilection are the face, the forehead, the scalp, the back of the neck, the shoulders and scapular regions; the thorax, particularly on its posterior aspect; the gluteal regions, the limbs, more commonly on the outer aspects and near the elbows and knees, occasionally about the wrists or the back of the hands, and rather exceptionally on the palms and soles. When thus developed upon certain regions the tubercular syphilide shows a tendency to the grouped arrangement of its lesions, in some cases circular and again irregular. Upon the forehead, where it is frequently seen, it often forms an irregularly triangular group, with the apex at the glabella and the base near the margin of the scalp, along which it also shows a tendency to develop in the shape of a semicircular band or corona, thus resembling an early and frequent distribution of the syphilitic papule which is called the *corona Veneris*. It also appears in a scattered or irregularly grouped form over the forehead, particularly toward the median line. On the face the tubercles usually appear first about the alæ nasi, and from there spread outward upon the cheeks and upward over the forehead. Upon the face, as well as upon the forehead, the tubercles show a marked tendency to appear in successive crops, usually at the margins, and perhaps at a distance beyond the original patch. They may be scattered without any particular order or may appear in a more or less circular arrangement.

When the tubercles are very numerous and hypertrophic upon the face, a peculiar leonine expression is given to it which has been termed

ten, inches in diameter. An excellent idea is conveyed of this form of eruption by Fig. 203. The tubercles are usually not much elevated, a

FIG. 203.



Tubercular syphilide in a large patch with much scaliness.

sharply marginated, and commonly look like patches of thickened and reddened skin covered with a greater or less quantity of imbricated scales. The color of the lesions is a deep red, a coppery-red, or sometimes a red bordering upon purple. The surrounding areola is, as a rule, narrow and of various shades of red. The individual lesions run an aphlegmasic and chronic course. They are exceptionally developed in the shape of circles, and may, particularly when irritated, fuse together into large and diffuse patches, which are usually accompanied by decided hyperæmia. This is frequently seen upon the legs. In some cases tubercles increase at their margins and undergo atrophy in their centres. Atrophic changes in the middle of tubercles are commonly seen after they have reached a diameter of an inch. Several or many tubercles may undergo ulceration, and not infrequently does this occur upon parts subjected to friction and pressure. In general, this form of tubercular syphilide is more prone to degeneration than the first variety. Upon parts where the circulation is very active or where there are many sebaceous follicles colloid degeneration may occur.

The earlier the evolution of this syphilide, the more copious and disseminated is the eruption. At later periods it is more localized and the tubercles less numerous. Its course is very slow, occupying weeks, months, and years. This syphilide shows a marked tendency to relapse, and is somewhat peculiar among its congeners in the fact that it retains its own individuality for such long periods.

The atrophic spots left after absorption of the tubercles are usually sharply defined, at first of a dark-brown color, which gradually gives way to a dull-white tint. A ring of pigmentation often remains around an atrophic cicatrix for a long time.

The concomitants of this syphilide when occurring early are perionychia, alopecia, iritis, cerebral affections, testicular lesions, and condylomata. Later on it may coexist with cachexia or osseous periosteal and visceral lesions.

Diagnosis.—Such is the clearly-marked appearance of this syphilide that errors in diagnosis should be very rare. Upon the face an eruption of conical tubercles in groups or patches might be mistaken for lupus. The tubercles of the latter are less regular in outline, not circularly grouped, and pinkish rather than brownish-red in color, frequently studded with colloid masses, and very prone to ulceration. With the specific lesion there is usually a history of infection or of antecedent lesions, or a coexistence of other specific lesions or their sequelæ or symptoms. Lupus usually begins before puberty.

Tubercles of leprosy may resemble those of syphilis, sometimes very closely. They, however, are almost always accompanied by patches of white anæsthetic skin, by nerve-swellings, perversions of sensation, nodular infiltrations and ulceration, and, moreover, there is commonly a history of the disease.

The second form of the tubercular syphilide may be mistaken for psoriasis, but care in the study of the history of the case will usually put the observer right. Besides its syphilitic history, and frequently the presence of sequelæ of other specific lesions, the tubercular syphilide is peculiar in the fact that atrophic changes are very soon noticed in the centre of the lesions, and that some of them, few or many, may undergo ulceration. These features are not observed in psoriasis.

THE ULCERATIVE SYPHILIDES, EARLY AND LATE.

Besides the impetigo-form and ecthyma-form syphilides, which sometimes show a tendency to active ulceration, there are a number of syphilitic ulcerative eruptions which may appear early or in the secondary period, and which are called "malignant precocious syphilides." They vary in the copiousness and extent of the lesions and in their duration. These eruptions may thus begin in a malign and destructive manner, or the ulcerative tendency may be engrafted on the syphilides, papular or pustular, which began without any malignancy. As a general rule, some excessively debilitating influence or lowered state of nutrition is the cause of the activity of the syphilitic poison. Alcoholism is a prolific source of malignant syphilis.

These early syphilitic ulcers are quite deep, have sharply-cut, somewhat undermined edges, and secrete a foul pus. They are prone to

appear upon the scalp, the face, the trunk, par
posterior portions, and the extremities, more cop
surfaces, and usually involve several regions an
body. They appear in crops or as a general eru
rule, show a tendency to a circular distribution.

A more pronounced form of early malignant
going has been called by French writers *syph*
ulcéreuse. It begins as small pea-sized, deep-red
undergo degeneration, forming ulcers which ar
punched out, have foul necrotic surfaces, secret
become covered with crusts. This eruption is p
face and scalp, the upper extremities, the trunk,
the whole body. It often produces great ravage
fusion of a number of lesions, and over the b
disfiguring cicatrices. This syphilide may appe
in crops or as an extensive eruption. Its course i

A more severe form of early destructive syp
not common, had been called by the French
gréneuse. It appears in broken-down subjects
tubercles which become the seat of a black cen
rapidly destructive ulceration proceeds. The r
have a foul, brownish-red, necrotic, uneven surfa
and a fetid secretion.

The invasion of this syphilide is rapid, th
region after region in successive crops, perhaps
then more sluggish in their course. In very bad
rapidly destructive course is observed, which
have called "galloping." The sites of election
extremities, and also the trunk and lower limbs.

In these cases of precocious malignant syphil
haustion coexist in proportion to the destructiv
territory invaded. In many cases a fever of ty
Visceral diseases frequently arise and lead to
from exhaustion.

The late ulcerating tubercular syphilides are
course, more localized in their distribution, and
than the foregoing eruptions.

Either of the varieties of the resolutive tube
any time during their course become the seat of
the destructive process which thus overtakes t
eruption is caused by lowering of the nutrition
cause or from traumatism. Owing to pressure,
tants of any kind, one or more tubercles may l
melt away, and be replaced by ulcers which i
whole of the original lesion. These ulcers ha
undermined, edges, a smooth, foul surface, a th
pus, and are surrounded by a red infiltrated are
cases all of the lesions undergo this necrobioti
invasion may be rapid or slow, but the subsequ
is chronic and aphlegmasic. Upon healing,
respects to those of the dry tubercles are left.

THE SERPIGINOUS SYPHILIDES.

We apply the term "serpiginous" to a chronic, more or less destructive syphilide which by its ulcerative process creeps over large surfaces of the integument. Though other syphilides, such as the pustular, ulcerating, and tubercular, sometimes show a tendency to extend in a serpiginous manner, such a course is only an accidental feature in their history; they should not be denominated serpiginous syphilides. This term, therefore, should be reserved for those lesions whose essential course is in ulcerating at their periphery while they heal in their centres.

There are two quite well-marked forms of the serpiginous syphilide, the superficial and the deep, the first being peculiar to quite early periods of syphilis, sometimes even being precocious in its evolution; the second being in all respects a late manifestation, appearing as early as the second and as late as the fifteenth year.

The superficial serpiginous syphilide begins as a papule which falls into ulceration, as a pustule, generally of the impetigo-form, the variola-form, or ecthyma-form syphilide, as a scratch, a bruise, or a fissure, which becomes irritated and encrusted. In its early stage the eruption has no distinctive characteristic: it simply appears like a superficial round or oval ulceration covered with a thin, not very adherent, flat crust. This patch, treatment not being adopted, extends until it reaches an area of one or two inches. At this time the ulceration increases in activity at the margin, while in the centre granulations which have formed under the crust become in a short time glazed; the central crust then falls, leaving an islet of cicatrization surrounded by a furrow of ulceration, outside of which is a deep-red areola of varying width. The serpiginous syphilide is then fully developed. The color of the crust at first is of a yellowish-green, which gradually deepens into a greenish-brown or black. The ulceration goes on slowly at the margin of the patch, being more or less covered with a rim of encrustation, the formation of which keeps pace with the destructive process. While these changes are taking place in the periphery, healing of the enclosed surface goes on *pari passu*, so that the width of the ring of crust is steadily maintained. The centre of the healed surface then becomes blanched, while the outlying portions of it still remain of a dull-red color. This blanching process also usually keeps pace with the peripheral ulceration and central healing surface. When healing begins in the marginal furrow, the crusts become harder, drier, and darker, and are noticeably more salient than before, by reason of their being lifted up by newly-formed granulations. When they fall off or are removed they expose an exulcerated ring, which may or may not be slightly depressed below the skin-level. At this time careful cauterization with a solution of nitrate of silver will soon produce a cure.

When small, the ulcer generally increases throughout its whole periphery, preserving its round or oval shape; and this may be the case even when it becomes quite large, as is shown in a typical case, in which the serpiginous syphilide, having begun upon the shoulder, has gone upward on the neck, forward to the clavicular region, and downward on the back, progressing in all directions with equal rapidity. The extension of

the ulcer is largely influenced by the tissues in which it is seated. Thus on the inner surface of the forearm and on the legs it creeps up and down much more rapidly than it does on the outer aspect. On the face, where this syphilide is somewhat infrequently found, its ulcers are of a quite uniform round shape. On the trunk irregularly oval lesions are usually observed, seated in the line of obliquity of the ribs.

This syphilide may last a few or many months, and even years. In many cases the ultimate destruction of the skin is decidedly slight, very superficial atrophy having been produced even after a protracted course.

The *deep serpiginous syphilide* originates in one of the late or tertiary lesions, such as a tubercle, a deep ecthyma-form pustule, or an ulcerating gumma. (See Fig. 204.) From any of these deep-seated,

FIG. 204.

The deep serpiginous syphilide, showing much cicatrization of the abdominal wall.

necrobiotic tubercular foci there is soon developed a deep, sharply-cut, active ulcer with undermined edges and a coextensive crust. This ulcer increases in size more or less rapidly until it covers an area of two or three inches, when similar changes to those in the first variety take place. The crust falls from the cicatriform centre, but remains intact at the margin of the patch in the shape of a ring of less than an inch in breadth. Under this encrusted ring the morbid changes peculiar to the syphilide take place. The underlying ulcerating ring consists of a furrow from half an inch to one inch wide and one or two lines deep. It has a foul, grayish-red floor and a sharply-cut, slightly-everted, and undermined edge, which is of a deep-red color and extends as an areola

which fades away into healthy tissue. In its early stage the destructive process in this ulcerating furrow is continuous and active, while later on it may be quiescent in certain segments, where granulations may form. Over the more active segments greenish-brown or dark brownish-black crusts may form, which may be on or below the level of the skin. When healing is progressing, however, the crusts become hard, dry, and adherent, and decidedly elevated, owing to the fact that granulations have filled up the ulcerating furrow and lifted them up. Stated in few words, the nature of the morbid process in the serpiginous tubercular syphilide is a proliferation, at its margin in the everted lip of integument, of the peculiar granulation-cells of syphilis, which is rapidly followed by ulceration, which exists in the enclosed furrow and within the ring of ulceration; healing takes place synchronously within this circle and keeps pace with the outlying ulceration. It is a good example of simultaneous new growth and decay. The extension of this syphilide is always in the manner described, and never by the breaking down of outlying, sharply-limited tubercles, as occurs in the non-ulcerative and ulcerative tubercular syphilides. In some cases papular and pustular lesions are found beyond the periphery of the syphilide; they are usually, however, due to the irritation of the secretion of the ulceration or to traumatism.

The cicatrices left by this syphilide vary considerably in their appearance. Upon the continuity of the limbs and on the anterior aspect of the abdomen they are usually thin and smooth, while those seated near or over joints are uneven, traversed by fibrous bands, and often firmly condensed with the subcutaneous tissues. These scars, like those of all deep ulcerating syphilides, are not uncommonly the seat of false keloid, particularly when near joints. The existence of dense fibrous bands and of cicatricial keloid near joints often produces deformity and even fixation of a limb.

The color of the scars is at first a dull deep red, which slowly becomes pale from the centre outward. In very large scars pigmentation may remain for several years.

The serpiginous syphilides of both varieties are peculiar in the fact that periods of activity and latency are very constant in their course. Such, however, is their persistency that a cure cannot be said to have resulted until every portion, even the most minute, of the ulcerating ring is thoroughly cicatrized. Relapses may occur by ulceration of the cicatrix, which may be local or general. This relapsing ulceration has none of the peculiarities of the original serpiginous lesion. It is usually caused by traumatism, in consequence of lowered nutrition, or by the disturbances resulting from alcoholic indulgence.

The course of this syphilide is always slow, chronic, and aphlegmasic, usually lasting months, and sometimes years. It may or may not be accompanied by cachexia. It is sometimes seen in subjects who seem otherwise perfectly healthy. The deep serpiginous syphilide may appear as early as the second and as late as the fifteenth year of infection. It is prone to develop upon the continuity of the limbs, mostly on their anterior aspect; about the shoulder, from which it may attack the neck; upon the back, where it is sometimes of vast extent.

Prognosis.—In the majority of cases the general health is not seri-

ously impaired by the existence of the syphilide. In those cases in which there is cachexia the health may be restored by appropriate treatment, provided there are no visceral complications. Such are the slow, painless course of the lesion and its usual comparatively dry and encrusted condition that in many cases it soon ceases to cause annoyance unless it is near a joint. The possibility of the local destruction, with the subsequent cicatrix and perhaps fibrous bands, renders the prognosis in most cases not good. Energetic and persistent treatment, however, will promptly effect a cure.

Diagnosis.—The serpiginous syphilides may possibly be mistaken for serpiginous lupus and serpiginous chancroid. Such, however, is the clearly-marked physiognomy of the lesion, very often supported by a history of syphilis, that a diagnosis is seldom difficult. Lupus usually begins in early life and chiefly attacks the face. Its ulcerations are less definite, regular in distribution, and sharply cut than those of syphilis. The lupoid ulcerations are covered by light-yellow or bluish-brown crusts scattered among surfaces of cicatrization which are always uneven and fibrous. Intermingled among these typical lupus lesions are red tubercles of various sizes and shapes, which are also seen to appear beyond the outer margin of the affection.

A serpiginous chancroid usually has such a clear history of origin in a chancroid on the genitals or of a chancroidal bubo that a mistake in diagnosis can hardly occur.

THE PIGMENTARY SYPHILIDE.

Under the title "pigmentary syphilide" French, Italian, and American observers have described a peculiar chromatogenous affection consisting of more or less brown or yellowish-brown spots or patches appearing in the early months of syphilis as primordial lesions, and not as secondary discolorations. Of late years this form of eruption has been recognized in Germany, and it is regretted that German authors have contributed much confusion to syphilography by confounding discolorations secondary to the erythematous and papular syphilides with pigmentary anomalies which are essentially syphilitic in their nature.

The descriptions here given are chiefly based upon observations made in America by myself, with the light of the published experience of foreign observers.

The primordial pigmentary anomalies due to syphilis *consist essentially in a hyperpigmentation which may in whole or in part be replaced by a corresponding loss of color*, or leucodermatous condition.

The pigmentary syphilide is seen under three well-marked and quite distinct conditions:

1. In the form of spots or patches of various size;

2. As a diffuse pigmentation which may soon become the seat of patchy leucodermatous changes;

3. In an abnormal distribution of the pigment of the skin, in which, owing to the crowding out of the pigment in places, they become whiter, while the parts invaded become darker. In this form there is really no actual excess of pigment.

The pigmentary syphilide in the form of spots consists of round or

oval patches with either sharply marked borders or with ill-defined and jagged margins, of a light yellowish-brown or of a pronounced brown color, which is unaffected by pressure and the conditions of the circulation. In some cases of very delicate white skin the spots are so faint that they can only be distinctly seen in a strong light, and sometimes require to be observed in an oblique direction. Again, in persons of a dark skin they may present difficulties of detection.

The patches vary considerably in size—from that of a pea to an area of an inch or more, and exceptionally as large as the palm. They are usually discrete and rather sparsely scattered, but often occur in considerable numbers, when they may become confluent. They are neither elevated nor scaly, and the lanugo of the region is, as a rule, unaltered. In this form it is the rule to see the hyperpigmentation evenly distributed and sharply limited, and very exceptionally to see an areola of deeper pigmentation. In most cases the intervening skin is unaffected, though it sometimes looks whiter than natural from the marked contrast with the pigmented spots. The latter may remain in an indolent condition for weeks or months, particularly in cold weather, or they may gradually wither and fade and leave no trace. Again they may disappear by the development of a leucodermatous ring around each patch, which extends centripetally until it absorbs all the excessive pigmentation and leaves a corresponding pigmentless area. This discolorizing process may attack several or all of the spots. In the latter case a pseudo-leucoderma is produced; and, if the case is only seen at that stage, I can well understand that its observer might come to the conclusion that the essential lesion was an atrophy of pigment, and not primarily a hyperpigmentation. In some cases of secondary leucodermatous involvement a pinhead-sized brown macule is left in the centre of the spot. The pigmentless condition of the skin may last several weeks or months, but gradually the normal color returns. In those cases in which there is simply gradual absorption of the excessive pigment the normal color of the skin returns *pari passu*.

The second form of the pigmentary syphilide is far more common than the first. More or less slowly the part invaded, usually the neck, becomes in a greater or less extent of a dull dirty-brown color. The affection usually begins on the sides of the neck or on the back of it, and from there it spreads until it involves almost if not all of its surface. From the neck it extends anteriorly over the breasts and posteriorly for a short distance down the centre of the back. The color varies in different cases: in some it is of a light *café-au-lait* color, while in others it is of a light, and again even of a pronounced, brown tint. In many and mild cases the brownish discoloration passes unnoticed, or it is ascribed to the action of the sun or the friction of the clothes; in others, however, it is soon discovered and often attributed to uncleanliness. When a goodly-sized patch or patches, say of the size of one's palm, becomes discolored, a number (sometimes few, sometimes many) of minute round, oval, irregular, and even linear white spots may be seen scattered without order over the affected surfaces. These white spots usually grow slowly in size, and are soon distinctly noticeable. Very often a patient is ignorant of any trouble until she is told her neck is getting white. The spots are sometimes distinctly whiter than the

normal skin; at other times of normal skin color, though they usually strike the observer as being whiter than normal, owing to the pronounced dark background. They may or may not be sharply marginated, in some cases the line of demarcation being sharp, in others rather indistinct. Sometimes quite rapidly, and again rather slowly, these patches grow in size until the appearance resembling leucoderma is very striking. As they increase they frequently fuse together, and less and less is seen of the pigmentation. Very often a condition is produced which may be compared to lace with large meshes, the interstices being formed of the white spots and the strands of the lace being formed by the, as yet, unabsorbed round, gyrate, oval, and irregular pigment-lines or bands. In the end these remnants of the hyperpigmentation disappear, and in the course of several months the parts become normal again.

In the study of these cases during the activity of the process I have sometimes seen very mild and ephemeral hyperæmia which would have escaped superficial observation, and the question is yet unsettled in my mind whether there is not a mild form of congestion which precedes the hyperpigmentation. My studies of these cases in this country cause me to marvel at the emphatic statements of some German authors, who say that the process of depigmentation occurs in previously unaltered skin, and who unequivocally call the affection leucoderma. I have recently seen two well-marked cases in which it has been distinctly seen that shortly after the invasion of the dark patches white spots began to appear, and I have seen the same process in many other cases. Such is the uniformity in the course of this form of the pigmentary syphilide that I can hardly understand how two opinions are held.

The third form of this specific chromatogenous affection is the least common of all. Its mode of invasion is slow—like the rest—aphlegmasic, and uncertain. In it there seems to be no actual hyperpigmentation. The natural color of the skin becomes white in spots of irregular size and shape, the margins of which then become dark, and as the blanched spots grow in size their brownish framework becomes more pronounced. It seems to be essentially a displacement of pigment. In my experience this form is usually confined to the sides of the neck, and does not, as a rule, involve the whole surface. Its progress is slow, and from its evolution until the skin again becomes normal several months may elapse.

This affection appears early or late in the secondary period, and may or may not coexist with other syphilitic manifestations. It may appear as early as the second or third month of the diathesis, usually at the sixth month, and during the second and even third years. It is most frequently seen in persons up to the age of thirty-five, and it is extremely rare to see it in older persons. It is in the vast majority of cases seen in young females from fifteen to twenty-five years of age. It is a rather uncommon manifestation in the male sex.

It is most commonly found on the neck, especially its lateral portions. It is less frequently seen on the face (forehead more frequently), and may be seen on the trunk, especially its upper and lower portions, where the skin is fine, and chiefly on the upper parts of the extremities, especially their inner and flexor surfaces. It must be distinctly remembered, however, that elsewhere than on the neck pigmentations and sub-

sequent leucodermatous spots not very uncommonly follow the erythematous and papular syphilides, and that such secondary processes are not by any means the pigmentary syphilide.

This syphilide is seemingly uninfluenced by mercurial treatment, systemic or local. In the light of the history of most cases and of the striking character of the discolorations a diagnosis is usually very easy. It is well to bear in mind that chloasma, leucoderma, tinea versicolor, the pigmentation caused by scratching, and the spots of increase or loss of pigment caused by psoriasis, and some erythemata, may present features resembling the chromatogenous disturbance induced by syphilis.

THE BONES.

In the secondary stage of syphilis the bones are sometimes the seat of localized swellings, but they are not infrequently involved in the tertiary stage by osteoperiostitis, osteitis, osteomyelitis, and gummatous infiltration.

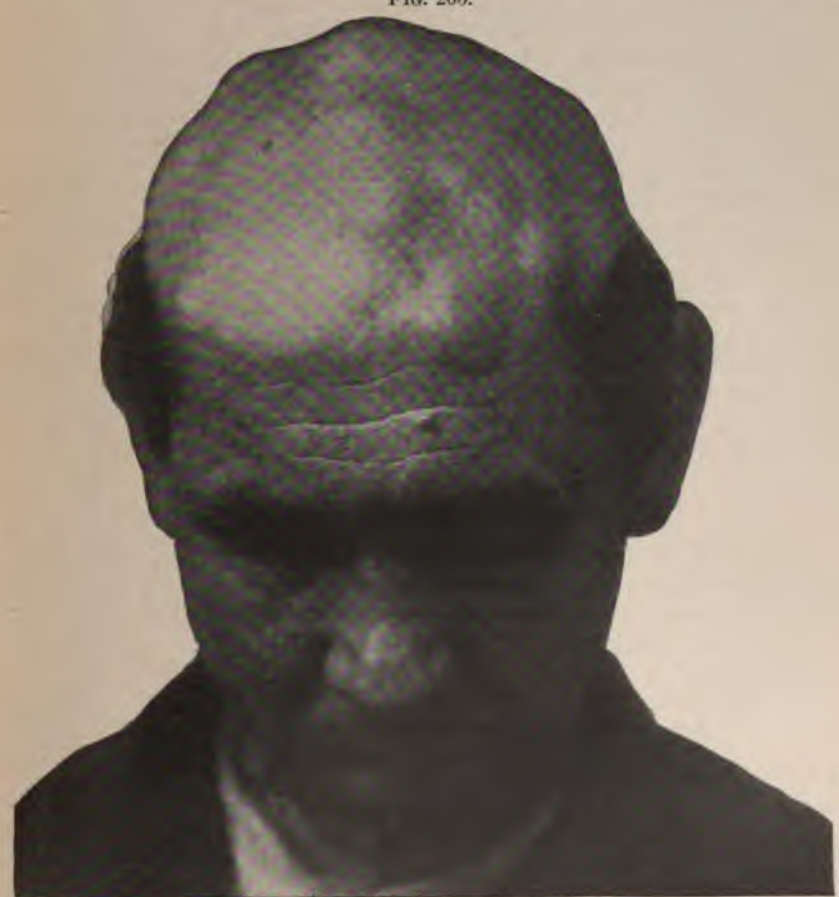
The bones most liable to be attacked by osteoperiostitis are those which are the most superficial, as the tibia, ulna, clavicle, sternum, and cranium, but no portion of the skeleton can be said to be exempt. The external manifestation of this affection consists in ill-defined, doughy tumors of variable size, shading off gradually into the surrounding tissues, adherent to the osseous structure beneath, but independent of the overlying integument, usually very sensitive to pressure, the seat, at certain hours in the twenty-four, of severe pain, and bearing the common name of nodes. A striking peculiarity of the pains produced by nodules is their marked nocturnal character. They are generally absent or are scarcely felt during the day, but return at night with great severity, after the patient retires to bed, and only abate toward morning. This nocturnal exacerbation is attributed to the warmth of the bed by Ricord, who states that in bakers and others, who are obliged by their occupation to turn day into night, the pains are chiefly diurnal. This explanation, however, does not appear to hold good in all cases, for in some they return at a certain hour in the evening whether the patient has or has not retired, and in a few instances they are equally as severe during the day as at night. These pains sometimes exist without the appearance of any organic lesion, and in such instances have been regarded as the direct effect of syphilis, but it is extremely probable that they are always dependent upon changes, however slight, in the periosteum or bone. The student should notice the difference between these pains and those attending early secondary symptoms, the former being confined to certain regions, usually the continuity of the long bones and those portions of the skeleton which approach nearest the surface, and nocturnal in their character, while the latter affect by preference the neighborhood of the joints, and rapidly change their locality from one part of the body to another.

The swellings produced by syphilitic osteoperiostitis are, as already stated, called nodes, in contradistinction to the more compactly developed exostoses. When eburnation of the bony tissue is developed the result is exostosis. Such new growths are often, for a time at least, movable upon the bone beneath, and are then called *epiphysary exostoses.*

In this form they are due rather to periostitis than osteitis; they are generally of small size, sometimes thin and flat, sometimes hemispherical or pedunculated, and at times annular. They acquire greater consistency with time and finally present an eburnated texture. Arrived at this point, resolution is no longer possible; the tumor remains stationary, and treatment has no other effect than to quiet the osteocopic pains. If resolution be attained at an early period, their surface, which before was smooth, becomes irregular, indicating partial absorption. Sometimes this absorption continues after the whole of the tumor has disappeared, so that local atrophy of the bone succeeds the exostosis. In other instances syphilitic exostosis is not preceded by periostitis, but is the result of osteitis terminating in hypertrophy of the normal bony tissue, in which case it is denominated *parenchymatous exostosis*.

An exostosis situated externally rarely occasions sufficient incon-

FIG. 205.



Multiple nodes of the skull bones.

venience or deformity to necessitate its removal by an operation unless under peculiar circumstances. An exostosis may, however, spring from

the internal surface of the cranial bones and give rise to symptoms of the most serious character, as convulsions and the various forms of paralysis. The frontal bone is by far the most frequently affected in this manner. Syphilitic exostosis of the vertebræ, either external or within the spinal canal, is rare.

Syphilitic exostoses may generally be distinguished from similar growths due to other causes by the nocturnal pains attending them, by their usually occupying the continuity of the more superficial bones, by their hemispherical form, and by the fact that they are rarely either multiple or symmetrical on opposite sides of the body.

GUMMATOUS OSTEOPERIOSTITIS AND OSTEOMYELITIS.—The bones most commonly attacked by these processes are the long bones, the cranial bones, and the bones of the fingers and toes.

When the bones of the skull are affected, one or more nodes are developed (see Fig. 205). As a rule, in the late secondary and in the early tertiary stages we find several, or, in rare cases, as many as twenty, nodes on the cranial bones, whereas at late periods there may be but one or two. These multiple cranial nodes usually make their appearance by one node or more at a time being added to the crop. Single nodes run a slow course, and one may be followed by its successor after the lapse of months or years.

The bones of the face, particularly the malar bones, may be attacked by gummatous osteoperiostitis, and in the course of the affection mild or severe neuralgic pain may be felt. The superior maxillary bone is not infrequently attacked. The first symptoms are local swelling and pain, and later on the cheeks and the tissues around the eyes become red and œdematous. Very often the whole bone is destroyed. In some cases the periosteum is left intact and a new bone forms. The inferior maxillary may be the seat of nodes on its external surface or lower border. According to Chabaud rarefying osteitis may occur in this bone and destroy the alveolar arches. Spontaneous fracture has been observed in cases of gummatous osteoperiostitis of the inferior maxillary bone.

AFFECTIONS OF THE JOINTS.

The joints are frequently affected by syphilis in both the secondary and tertiary stages. In some instances the morbid process begins in the joint-structures, and in others inflammation of the articular ends of the bones and of the large tendons inserted near the joints involves the latter secondarily.

SYNOVITIS OF THE LATE STAGE.—The synovitis which occurs late in the secondary and during the tertiary stage is also markedly subacute. It is attended with the same symptoms, and is mainly distinguishable from that of the earlier period by appreciable lesions of the joint-structures. The attention of the patient is called to the affection by slight pain and impairment of motion, and the joint is then found somewhat enlarged. The effusion into its cavity takes place slowly and perhaps intermittingly, so that in many cases several months elapse before the joint is very decidedly enlarged. When the affection is fully developed we find evidence of intra-articular effusion and general thickening of the fibrous coverings and of the synovial membrane. The affection has

been called by Richet, who first described it, "syphilitic white swelling," and it was said by him to be due to gummy infiltration into the subsynovial connective tissue and into the reflections of the membrane which lines the joints. It is probable that this is the chief focus of the lesion, but in some cases there is a coexisting hyperplasia of the fibrous structures of the parts. This affection may remain in an indolent condition for years without undergoing any further changes. There is little tendency to complete ankylosis, though quite frequently there is more or less erosion of the articular cartilages, as shown by the crepitation on motion. We seldom find sinuses near the joints, and the stationary character of the affection is in marked contrast to the tendency to degeneration which is such a prominent feature of the strumous affections of these parts. The knee-joint is the one most commonly attacked.

Late syphilitic synovitis may be complicated by *tuberculosis*, and the mixed condition then produced is very rebellious to treatment, which is sometimes signally efficacious in the true syphilitic affection. In many cases a history of syphilis points to the nature of the affection. Then, in tuberculosis this morbid process usually exists elsewhere, particularly in the lungs. In the mixed form of synovitis it is often impossible to make a sharp diagnosis.

The **prognosis** of this affection is rather more serious than that of the earlier form. If it is submitted to treatment early, it is in general curable, but if it is neglected, permanent thickening occurs, and consequently more or less impairment of motion.

The constitutional **treatment** consists in the administration of the iodide of potassium and of mercury. Locally, frictions with mercurial ointment may be used.

In some cases in which there is a syphilitic affection of the tendons inserted near a joint there is a coincident effusion into the cavity of the latter. This occurs slowly and painlessly, and disappears on the subsidence of the disease of the tendon.

DACTYLITIS ("syphilitic panaris").—Besides being the seat of primary and secondary lesions, the fingers and toes are, in the tertiary period, attacked by gummy deposit in their subcutaneous connective tissue and by infiltration and inflammation of their bones. This affection was formerly called syphilitic panaris. I use the term *dactylitis*, derived from the Greek *δάκτυλος*, a digit or finger, as being more correct and expressive. The affection is caused both by acquired and by hereditary syphilis. The cases due to the former are much less numerous, there being under four dozen reported up to the present time, whereas hereditary dactylitis is by no means uncommon. In this section the acquired form will be described. Of this there are two varieties: first, that in which the subcutaneous connective tissue and the fibrous structures of the joints are involved; second, that in which the morbid process begins in the bones and periosteum, secondarily implicating the joints and perhaps accompanied by deposit in the subdermal connective tissues. These varieties are constantly found, and their adoption will simplify description. The size of the affected member is materially increased and its mobility is more or less interfered with. The lesion comes on slowly, and first attracts the patient's attention by the slight enlargement of one or more fingers or toes. The swelling gradually increases and the member be-

comes hard and firm. When the toes are affected their whole length is generally included; but when a finger is attacked the lesion may be quite sharply limited to one phalanx, almost invariably the proximal one, or the adjacent phalanx may be involved to a less degree.

These swellings are usually developed slowly and painlessly, but in some cases a dull aching pain is present. When the infiltration is complete it is impossible, on account of the density of the tissues, to determine accurately the condition of the bones, although they seem to be thickened. As the affection subsides the bones and joint-structures can be more thoroughly examined, and we then find more or less periosteal thickening. In most cases, however, the bones are quite superficially involved, whereas in the second form of dactylitis they are profoundly attacked. It is impossible to say whether the morbid process begins in the periosteum or in the connective tissue over it; it is certain that the lesion is sometimes sharply limited to the tissues over one or more phalanges, and, again, it may involve the whole member.

Within a few weeks after the development of the affection symptoms of joint-implication appear. At first flexion of the joints is impaired by the swelling. In the course of one or two months, if no treatment is followed, the joints become flaccid and unnaturally mobile. Sometimes in this variety of dactylitis there is slight hydrarthrosis and often crepitation in the metacarpo-phalangeal joint or between the articular surfaces of two phalanges. This will be again referred to in speaking of the second form of dactylitis, next to be described.

This gummous infiltration of the integument and periosteum of the fingers and toes may be limited to one of these members or may involve several. A single hand or foot, or both, may be involved, one or more fingers and toes being attacked simultaneously or in succession. The lesion, being a late manifestation, very often follows or accompanies gummous infiltration elsewhere. It runs a chronic course, and its early stage is amenable to treatment. The fact that gummy tumors of these parts are not prone to ulcerate is incapable of positive explanation. The character of the deposit is certainly not peculiar, but it may be that the vascularity and density of the tissues modify the course of the lesion. The wonderful reparative power of the fingers after injury is well recognized. This form of dactylitis generally results in restoration of the affected members, but in neglected cases the joints may be rendered permanently useless and the bones may remain enlarged. The nails either escape or, in very chronic cases, present minute transverse furrows, indicative of imperfect nutrition.

The first form of dactylitis is sharply limited to the bone, and is due either to specific periostitis or osteomyelitis. The affection may progress rapidly, slowly, or with intermissions. The earlier after the infection the lesion occurs, the more acute is its course. The degree of its induration is generally in proportion to the chronicity of its development; a rapidly-formed swelling may be so soft as to be susceptible of identification by firm pressure. The affection may be speedily cured by energetic and early treatment, but if unchecked it may progress to an extreme degree. It seems to be the rule that when only one bone is affected the swelling is greater than when several are. The shape of the swelling depends upon the phalanx attacked. When the first phalanx is involved

it may assume an acorn-shape or the appearance of a balloon; the second and third phalanges may be fusiform or cylindrical. In most cases the whole bone is involved. The disease may be limited to the extremity of a phalanx adjacent to one already the seat of dactylitis (see Figs. 206 and 207). The proximal phalanx is most frequently, the distal phalanx

FIG. 206.

Dactylitis syphilitica.

FIG. 207.

Dactylitis syphilitica.

least frequently, involved. I have seen in four instances enlargement of the second phalanx only, and of the third in one case. In hereditary syphilis it is not uncommon to find swelling of the second and even of the third phalanges.

The fingers are attacked more commonly than the toes; in a few cases they have been involved simultaneously. More than one phalanx of the same finger may be affected, as well as several fingers, either unilaterally or symmetrically. In the latter case swelling of one or more

toes is likely to occur at the same time. Other osseous lesions may coexist, and articular affections and gummous infiltrations of the skin may be associated with these lesions of the fingers.

Hereditary Syphilis.

Hereditary syphilis, less correctly called "infantile," and "congenital," is that form in which the disease is transmitted *in utero* to the offspring from one or from both parents. As a rule, the transmission ends with the second generation, but rare cases have been observed in which it is pretty conclusively shown that syphilis may be transmitted to the third generation.

Hereditary syphilis in its course differs in very many respects from the acquired form, to which, however, it has some points of resemblance. Unlike the acquired disease, in the inherited form there is not the initial lesion with its periods of incubation, nor is its evolution as regularly typical as that of the former.

Hereditary syphilis is severe and deadly in proportion to the activity of the virus in the parent or parents of the affected child. When both parents are in the active stage of syphilis, abortion usually occurs, or a child profoundly syphilitic is produced and soon dies. As a cause of death in infants hereditary syphilis has always been a powerful factor. The immature and rapidly growing organism of the embryo is profoundly influenced by the poison. In general, though not always, the severity of the disease in the offspring decreases with each succeeding child. Further, the chances of life in the child increase with age, and are usually much better when it reaches six months or one year or more of age.

There is an absence of precise statement on the part of some authors as to the date of appearance of hereditary syphilis, their words giving the impression that it may be as late as the first or second year or even later. The consensus of opinion of most syphilographers is, however, that the symptoms appear usually within the first three weeks of life, and sometimes even at birth. My own opinion is strongly in favor of the view that some evidence of the disease, mild and insignificant perhaps, or possibly severe, show themselves before the end of the third month.

The lesions of hereditary syphilis are found in every organ and tissue of the body, and they are, as a rule, more hyperæmic and active than those of the acquired form. The early manifestations are generally and symmetrically distributed, while those of later dates may be localized and unsymmetrical.

Vesicular and bullous syphilides, so rare in the acquired form, are not infrequently seen in hereditary syphilis, in which rupia is most uncommon. The nasal mucous membrane, which in the acquired disease is, if at all, involved at a quite late period, is, as a rule, affected early and in a somewhat characteristic manner in hereditary syphilis. Gummatous infiltrations and visceral affections are common and severe in tainted infants.

As a rule, hereditary syphilis shows itself in a tangible form before puberty. There has been a craze of late years for hunting up and pub-

lishing cases of late hereditary syphilis, many of which are far-fetched and of doubtful authenticity. It is a good rule to consider as evidences of hereditary syphilis lesions of more or less typical appearance and character which have appeared before the eighteenth or twentieth year, more especially where there is corroborative evidence, and to look with caution akin to suspicion upon anomalous lesions which appear in the adult, and for the want of a more precise name are called "late manifestations of hereditary syphilis." It is an undoubted fact, however, that specific lesions sometimes appear after long periods of latency.

It is claimed that an hereditary taint gives a more or less complete immunity from the acquired disease, but much further evidence is wanting on the subject.

It may be stated as an axiom that syphilis is transmitted to the child as syphilis, and not in the form of scrofula, rickets, tuberculosis, and phthisis. The cachexia incident to hereditary syphilis may cause a predisposition toward these and other adynamic conditions. Certain late hereditary syphilitic lesions may present points of resemblance to lupus, but there is no pathological link between the two diseases.

It is now admitted by nearly all practical syphilographers that syphilis of the infant may be derived from the father alone, the mother remaining free from the disease. Instances of paternal infection are far more common than was at one time supposed. The transmission of the disease from the mother alone is conceded by all observers, while the fact is incontestable that both parents together may convey it to their offspring. The semen of a syphilitic man, though containing sperm-cells capable of originating the disease in the embryo, as already stated, does not possess infectious qualities for the mother, since it never, under any circumstances, when unmixed with specific pathological products, gives rise to the initial lesion.

Abortions resulting from syphilis occur usually about the sixth month or later, in somewhat rare cases earlier. An aborted syphilitic fœtus is generally in a macerated condition, perhaps more or less denuded of epithelium, of a livid or purple color, or covered with pustules or bullæ. Stillborn children may not present visible evidence of the disease. As a quite general rule, syphilitic children which come to term are at birth seemingly plump and healthy, and only begin to wither and show evidence of the taint at the end of the first month, and sometimes later. Usually the early evolution of specific lesions is indicative of a virulent type of the disease.

The **prognosis** of hereditary syphilis is never of a reassuring kind. It depends largely upon the condition of the parent or parents at time of procreation, and upon the extent and tendency of the lesions, since, besides the manifestations upon the skin and mucous membranes, pathological changes may exist in the bones of the skull, in the brain and spinal cord, in the lungs, liver, spleen, kidneys, and intestines, any or all of which may lead to death. Further, a condition of marasmus is not at all uncommon, and intractable gastro-intestinal disorders are prone to develop.

The usual first symptom of the disease is an inflammatory thickening of the nasal mucous membrane, the symptom of which, the snuffles, is very prominent and often distressing. Then a rapidly-increasing

emaciation begins, by which the subcutaneous fat is removed, leaving the skin wrinkled, of an earthy sallowness, and seemingly too large for the skeleton. The skin is drawn firmly over the bones of the head, hands, and feet. Coincidently the lesions of the skin appear at first chiefly near the mucous outlets and on parts covered with clothes and on those in coaptation. In this miserable condition the child comes to have a senile, worried, and anxious expression of countenance, and is said to resemble a "a little old man." The combination of symptoms expressive of hereditary syphilis in the very young is as follows: The old-man look, bullous and pustular eruptions (perhaps), deep and persistent erythema of the buttocks, neck, palms, and soles (and also of other parts), snuffles, laryngitis mucosa, enlarged lymphatic ganglia, fissures of the mouth and anus, and swellings of the bones, particularly of the long ones at their diaphyso-epiphyseal junctions.

The eruptions of hereditary syphilis are the erythematous syphilide; the papular syphilides of the skin and mucous membranes; the vesicular, pustular, bullous, tubercular, and gummatous syphilides.

THE ERYTHEMATOUS SYPHILIDE.

This eruption is usually the most frequent, and, with the exception of the bullous, the earliest of the hereditary forms. It is generally accompanied by roseola or mucous patches of the mouth, and sometimes by condylomata lata of the anus.

The erythematous syphilide begins on the lower part of the abdomen or on parts covered with the diaper, as minute round or oval pink spots, which is first pale upon pressure. It rapidly extends to the trunk, legs, upper extremities, and face. The spots vary very much in size, from a third of an inch to even an inch in diameter. As they increase in size their hue becomes darker, and may even reach a coppery tint. As a rule, the spots or patches are not elevated, though, owing to the intensity of the disease or irritation, more or less slight salience may occur. As they grow old and darker they become slightly scaly. About the head, chin, neck, around the buttocks and axillæ this syphilide sometimes appears in extensive and diffuse patches. In this condition a well-marked, but of course superficial, infiltration may be observed, which renders the skin rather less supple and elastic—a condition which may become so pronounced about the mouth, eyes, buttocks, hands, and feet that fissures may appear in the lines of motion. Early crops of this syphilide do not show a tendency to the circular form which is sometimes seen in later ones.

While in most cases this eruption is so pronounced in character that it is strikingly noticeable, it may be so faint and evanescent as to escape observation.

THE PAPULAR SYPHILIDE AND CONDYLOMATA LATA.

This syphilide is rarely, if ever, of the small conical form, as seen in the acquired disease, but is made up of quite large flat or plano-convex papules. It may appear as the first eruption or intermingled with the erythematous rash. Again, it may coexist with three or four varieties of syphilides. The lesions are round or oval, of a dull-red verging on

a coppery tint, and only slightly prominent; they are, in fact, the erythematous syphilide plus some moderate exudation and cell-infiltration.

Condylomata lata are hypertrophied and superficially exulcerated papules, and are found in the folds of the skin or at the junction of mucous and cutaneous surfaces. There may be one, several, or many. They are of round, oval, or irregular shape from coalescence, markedly salient, of a grayish or lilac-pink or dark-red color. Their surface is flat or plano-convex, more or less exulcerated, perhaps fissured, and from them a scanty, viscid, offensive, and highly contagious secretion escapes. These lesions are among the earliest, the most obstinate, and most constant of the hereditary diatheses. They are seen about the anus and also the mouth associated with buccal mucous patches, behind the ears, and between the fingers and toes. When left untreated, or irritated from neglect or want of cleanliness, they prove especially obstinate and prone to exuberant growth. They are much more amenable to local than to constitutional treatment.

Mucous patches are in reality immature condylomata lata, they being the result of hyperæmia and moderate cell-increase and exudation in mucous membranes. They are very prone to appear in the mouth and at its angles, and in the nares and larynx.

THE BULLOUS SYPHILIDE.

This syphilide, though rare in hereditary syphilis, is so very rarely seen in the acquired disease that it may be considered almost as the sole appanage of the hereditary form.

This eruption is the most precocious of all the syphilides of hereditary origin. It appears either within a day or two or a week after birth, usually within and not commonly after the first month, and is very often found on macerated and aborted children in the sixth or seventh month of gestation. Its development is as rapid as its appearance is precocious. In many cases it is confined to the palms and the soles; in others it may also be found, usually less characteristically developed on the limbs, particularly the lower ones, on the trunk, and on the face. Upon the palms and soles it reaches its fullest development, and there we find various bullæ, the contents of which have often in twenty-four hours changed from a sero-purulent to a purulent fluid. The lesions are seated upon a hyperæmic surface, often of a violaceous or purple tint, and again of a deep coppery-red hue. Elsewhere upon the body this tinted background may be wanting, and there is usually to be seen a more or less extensive coppery-red areola surrounding the lesions, which in these localities are not, as a rule, of as well-marked bullous character as are those of the hands and the feet; indeed, they are often more clearly pustular in nature.

This syphilide usually appears in one outburst, and in those cases in which there are several crops they appear promptly and with only short intervals between them. The lesions of later eruptions are usually not as fully and characteristically developed as those of the first outburst.

The course of the bullæ is variable. They commonly grow in size and coalesce. They may become desiccated and wither, leaving a deep-red but healed epidermis, or they may become the seat of ulcerations

which are of various degrees of severity, from the mild and superficial to the deep, destructive, malignant form.

The bullous syphilide is usually the expression of a profound infection, and is usually accompanied by visceral lesions. Its prognosis is therefore always bad. I have seen two cases in which recovery took place, and Neumann reports one case.

THE VESICULAR SYPHILIDE is almost always associated with the bullous eruption, and is really a dwarfed form of the latter. The vesicles are small, round, and conical, discrete or aggregated, and their transparent serum rapidly turns into pus. The sites of election are the face about the chin and mouth, the hypogastrium, the nates, the forearms, and the thighs.

THE PUSTULAR SYPHILIDE may exist as an individual eruption or as part of a bullous exanthem. The pustules are small, conical, seated on sharply marginated, red, infiltrated bases. They run an indolent course, sometimes drying into crusts, and again becoming troublesome ulcers. They may remain separate or become confluent, especially about the mouth and on the buttocks. At early periods the eruption is copious and symmetrically and generally distributed; later on it shows a tendency to sparseness and limitation. The lesions may leave no permanent trace or may give rise to scars.

THE TUBERCULAR SYPHILIDE is much rarer in the hereditary than in the acquired disease, and is even more prone to ulceration than in the latter form. Its clinical characteristics are those of the dry and ulcerative forms of the acquired disease, except that there is more commonly an accompanying hyperæmia and evidence of more inflammatory action. This syphilide may appear as early as the sixth month, or several years after birth. It is mostly found on the head and extremities.

Gummatous infiltrations are not uncommon on the skin of the face and extremities and mucous membranes, particularly of the mouth and larynx.

AFFECTIONS OF THE NAILS.

There are two forms of onychia due to hereditary syphilis—the ulcerative, or perionychia, and the malnutritive, due to the impairment of the nutrition of these structures.

The description of the perionychia of acquired syphilis already given, will in the main suffice for that of the hereditary disease. In the latter, however, the morbid process most commonly begins in a papule, pustule, or fissure in the fold of skin surrounding the nail.

There are no salient diagnostic features about these affections, and similar conditions are sometimes seen in the course of non-specific epidermal and dermal affections. The nails are rough, lustreless, striated longitudinally or transversely, much thickened, brittle, and friable, and they constantly catch dirt. With proper care and treatment, and with the improvement of the system, they may gradually become less deformed and perhaps perfect. Left uncared for, they remain as dwarfed and unsightly deformities.

THE TEETH.

There are certain malformations of the permanent teeth in hereditary

syphilis which are known as Hutchinson's teeth or "test teeth." In his description, now classical, Mr. Hutchinson says: "By far the most reliable amongst the objective symptoms is the state of the permanent teeth if the patient be of age to show them. Although the temporary teeth often, indeed usually, present some peculiarities in syphilitic children of which a trained observer may avail himself, yet they show nothing which is pathognomonic and nothing which I dare describe as worthy of general reliance. *The central upper incisors of the second set are the test teeth,* and the surgeon not thoroughly conversant with the various and very common forms of dental malformation will avoid much risk of error if he restrict his attention to this pair. In syphilitic patients these teeth are usually short and narrow, with a broad vertical notch in the edges and their corners rounded off. Horizontal notches or furrows are often seen, but they, as a rule, have nothing to do with syphilis. If the question be put, Are teeth of the type described pathognomonic of hereditary taint? I answer unreservedly that when well characterized I believe they are. I have met with many cases in which the type in question was so slightly marked that it served only to suggest suspicion, and by no means to remove doubt; but I have never seen it well characterized without having reason to believe that the inference to which it pointed was well founded."

It must be remembered, however, that these malformations are far from common, and that children hereditarily syphilitic may have sound teeth. The symptoms thus presented should receive due weight in the study of a case; but if much doubt should exist it would be well to seek for further corroborative evidence of antecedent inherited disease.

AFFECTIONS OF THE BONES.

The bones are variously and often extensively affected in hereditary syphilis. In the early months of life the most constant morbid change is at the junction of the diaphyses with the epiphyses of the long bones, though the small bones of the fingers and toes are often attacked. At later periods the tendency of the disease is to involve the shafts of the long bones and also the flat bones. The morbid process at the diaphyso-epiphyseal junction is called osteochondritis, while that of the long and flat bones is either proliferating or gummatous periostitis and osteitis. Either of these morbid changes may end in necrosis, in gelatiniform atrophy resembling dry caries (Parrot), in hypertrophy, or in osteophytic outgrowths.

OSTEOCHONDRITIS is of not infrequent occurrence, and its presence is of considerable diagnostic value. It shows itself in the form of fusiform and ring-shaped swellings at the ends of the long bones, chiefly those of the forearm, the leg, or the arm, that give rise to deep ulcers. In some cases the new tissue softens and melts, causing separation of the epiphyses from the shafts.

PERIOSTITIS is observed in older children, from the fourth or fifth year to as late as the fifteenth. It is often the seeming outcome of the child's use of its limbs, upper and lower. Usually, the greater part of the shaft is involved, the tibia and ulna being especially liable. Periostitis, particularly of the tibiæ, very often leads to elongation of the bone

and its bending with the arc outward—a condition described as sabre-shaped (Fournier).

The skull-bones are not infrequently the seat of gummatous periostitis, which undergoes degeneration and leads to much destruction of the bone and skin.

The swellings of the phalanges are not uncommon in the hereditary disease, nor indeed in the acquired form, and are called dactylitis syphilitica. The bones become rounded, fusiform, and acorn-shaped. The affection runs a chronic course, and may end in resolution, in necrosis, or in thinning, and even elongation, of the bone.

Treatment of Syphilis.

It is now generally conceded that syphilis, being a chronic disease, requires a prolonged and systematic treatment. To-day most syphilographers and physicians are in favor of a course of treatment lasting from two to three or four years—not, however, a continuous course of medicine, but rather a series of courses employed at intervals during these years according to the indications of each case. In general, in patients of fair average health with a proper attention to hygiene, two years or two years and a half of careful and progressive treatment are sufficient to cure them of their disease, as shown by the entire absence of any further signs of it whatever, and by the power of the patient to procreate healthy children. An experience extending over many years in the observation of a vast number of patients has convinced me of the truthfulness of this statement. The requirements for such future immunity are a good state of health, the docility of the patient to his physician, and a treatment begun sufficiently early and carried on in a watchful, painstaking, and thorough manner. The duties of the physician and patient are reciprocal. Though in very many cases such hopes may be held out to the person infected with syphilis, it must be remembered in persons of poor fibre, under-weight individuals, or those suffering from any visceral affection or who have previously suffered from rheumatism or gout, from malaria, or from any adynamic influence, and particularly persons addicted to alcoholic indulgence, a longer time is required and usually a less favorable outlook should be promised. The first duty of the physician is to acquaint his patient with the gravity of his case, to place clearly before his mind the fact that a serious ordeal is before him—that the ensuing two, three, or four years are really the most critically momentous ones in his whole life, and that his future health and happiness, and that of his family, hinge upon his care of himself during this trying epoch. With intelligent zeal on his (or her) part, this period may be passed with little or perhaps no discomfort, whereas carelessness and negligence will be fraught with suffering, disfigurement, and perhaps permanent impairment of health, or may even result in death.

Besides its lesions proper, syphilis tends to produce in the economy anæmia, cachexia, and even a condition of marasmus. Therefore, the hygiene and surroundings of the patient must be as nearly as possible perfect. Such patients require fresh air, plain, wholesome food, and, as far as possible, a life of peace and contentment. While all excesses should be carefully avoided, all influences exhausting physically or irri-

tating or depressing mentally should be removed. The daily regimen should be carefully looked after, and regularity of hours for food, business, and sleep should be observed. The changes of the seasons should be accompanied with appropriate clothing and the utmost precaution taken against catching cold. The condition of the digestion and the gastro-intestinal functions should be conserved, and, during treatment especially, all sexual excesses and lowering tendencies should be avoided.

While the physician should thus impress his patient with the gravity of his condition, he should also constantly hold out to him that most consoling hope that he will in the end be free from his disease. While some patients are light-hearted, and even indifferent to their physical condition, a few show a tendency to a depression of spirits and melancholy concerning their disease, which is termed syphilophobia—a most distressing state of mind both for the patient and his physician. Such cases should be treated with constant encouragement and kindness mingled with firmness.

The methodical treatment of syphilis should begin at the time of the evolution of the secondary manifestations in the vast majority of cases. As a rule, no good is produced by beginning treatment prior to this time, since it only tends to render the course of the disease less orderly, very often leaves the existence of syphilis in a state of doubt, does not prevent, but may perhaps retard, secondary manifestations, while it certainly does not in any way lessen their severity. Clinical and pathological facts show us that syphilis is not fully mature until the date of the evolution of the secondary manifestations. At this time the newly formed young round infecting cells are proliferated in vast quantities and are thrown into the general circulation, and through that carried to the skin and viscera. Then syphilis may be said to be ripe. Now we further know, by inductive reasoning and observation, that the one sovereign remedy for early syphilis—namely, mercury—acts by destroying and rendering fit for that absorption this young nascent infectious tissue. This is the sum and substance of its action. It is in no sense whatever a true tonic, and when, owing to its administration, the strength and forces are increased, nutrition improved, or the weight of the body increased, it is in consequence of its depurative action in ridding the economy of these cells, and perhaps the poisons they give rise to, which, scattered throughout the viscera, lead to impairment of functions, to disturbances of nutrition, and to emaciation. Is it not, therefore, illogical and irrational to introduce this essentially catalytic agent into the economy before the materies morbi has been developed? The greater number of practical thinking men who have studied this question on a large scale have reached the conclusion that the proper time to begin the systemic and systematic treatment of syphilis is at the time when the disease is ripe by reason of the infection of the economy by the actively nascent new growths. The abortive treatment of syphilis, both in the primary and secondary stages, is plausible in theory but nugatory in practice. It sometimes happens, however, that certain exigencies render the adoption of early systemic treatment necessary or imperative. These may be stated as follows:

1. Where the initial lesion from its size, depth, or extent causes much pain and discomfort or interferes with the function of parts, or from

activity of ulceration threatens to destroy them: prepuce, penis, urethra (chiefly in cases of phimosis and paraphimosis), clitoris, fingers, eyes, nose, lips, tongue, tonsils, breasts, and anus. Also in cases in which dense induration around the urethral orifice or in the urethral canal produces a stenosis of that canal, and again in cases of very large (elephantine) extra-genital chancres upon the legs, arms, buttocks, and cheeks or face.

2. In some cases in which there is a tendency to development of exuberant indurating œdema around the chancre, which may seriously discomfort or cripple the patient or impair the functions of the part, as we sometimes see in chancres of the lips, near the frænum, and upon the external female genitalia, and complicating chancres of the anus, and also in cases of chancres just within the vaginal introitus.

3. In certain of those cases in which, from its situation, the chancre may lead to infection of others, such as the fingers of surgeons, obstetricians, dressers, orderlies, and midwives, the nipples of wet-nurses and others who suckle children other than their own, in cases of chancre of the lips and tongue of infants, and in cases in which the lesion occurs on the lips or elsewhere of young, careless, and thoughtless persons who are liable to spread the infection.

4. When the enlargement of the lymphatic ganglia or the lymphatic cords (particularly of the penis) is excessive and causes inconvenience, impairment of function or locomotion or movement of the arms, or produces much discomfort and disfigurement in the neck and submaxillary region, at the elbow, in the axillæ, and groins.

5. In some cases in which chancres are complicated with a pyogenic infection attended with pain, fever, and perhaps typhoidal symptoms. In these cases the chancres may be seated on the fingers, but also, though rarely, on the nipples and mammæ, and sometimes on the penis and vulva (in careless, uncleanly subjects). Also in some cases in which gangrene and phagedena are complications.

6. In cases in which conjugal or sexual relations render the disappearance of the chancre necessary or imperative.

7. When the extreme anxiety and fear and the unreasonable impatience of the bearer render it imperatively necessary.

8. In those somewhat exceptional cases in which severe cephalalgia, neuralgia, pleuritic and intrathoracic discomfort and pain, pains in the bones, joints, and fasciæ, are precocious.

9. In cases of women infected in the early months of pregnancy, in order, if possible, to prevent subsequent abortion; and in cases of chancre of the vulva and introitus vaginæ in order to remove a possible obstacle to childbirth, and if very late in gestation, to prevent the infection of the child *in transitú*.

Among the vast number of remedies which have been vaunted in the cure of syphilis, mercury for the early stages and in compound form for later stages is the only one which has stood the test of time. Owing to various causes (chief of which is its intelligent use by medical men) this agent no longer has a bad reputation with the laity; it has ceased to be a popular bugbear, and we now seldom hear at least the better class of patients express the fear that their teeth and bones will decay, that their hair will fall out, and that other imaginary ills will overtake them from

its use. A more general and correct idea of the course of syphilis has taught the public that the disease, and not the remedy, is the cause of these troubles. Success in the treatment of syphilis has followed the intelligent and painstaking use of this great remedy, and progress has been mainly in the direction of the most eligible and efficient preparations and in the modification of administration and the attenuation of the quantity given.

Conceding, therefore, that mercury is the great and salutary agent in the treatment of this troublesome and oftentimes dangerous disease, we must add to this postulate the statement that even when administered in the most careful and watchful manner it is in some cases (happily, rather exceptional ones) attended with certain unpleasant phenomena—namely, stomatitis and salivation, gastric and gastro-intestinal disturbances, and impairment of the nutrition of the body and depression of the vital forces. In the majority of cases these conditions act only as temporary drawbacks, and they can be obviated or dissipated by forethought, tact, and skill. Let us consider them briefly.

Ptyalism is in general a condition which can be prevented and aborted by care and watchfulness. It is true that its invasion is sudden and severe in some cases, particularly where blue pill, calomel, or even the gray powder is given in small and oft-repeated doses, and where inunctions are employed. But the knowledge of the possibility of this accident under these conditions enables one to guard against it. In general, the preparations now used cause this accident very rarely, not usually in a sudden outburst, and severe cases are to-day almost unheard of. Ptyalism (stomatitis and salivation) need have no terrors for the conservative surgeon.

Gastro-intestinal irritation is rather more frequently observed, particularly in weakly subjects or those with poor digestion. In most cases it can be overcome and a tolerance of the mercurial preparation established by care in attenuating the dose, in preparing the stomach by antacids, stomachics, and tonics, by the use of very digestible food, by the avoidance of alcoholic and malt liquors, and by supplementing the drug with some mild sedative remedy, such as opium (always, however, with extreme caution and in minute quantity, for fear of inducing addiction to it) or hyoscyamus. By these means gastro-intestinal intolerance may be overcome.

Profound nutritional disturbance in consequence of taking mercury is seen, on the whole, very rarely. This condition shows itself in debility and emaciation, with or without diarrhœa or gastric trouble. In most cases watchfulness, care, and skill serve to overcome it in a short time. In very rare cases so pronounced is the condition that the use of mercury seems entirely out of the question; in which event recourse may be had to hypodermic injections, to inunctions (both very cautiously), or to some preparation of iodine.

The advantages of the use of mercury being so great, and the drawbacks in the aggregate so small and usually so readily avoidable or removable, it remains to be determined how to properly employ it.

In the treatment of syphilis mercury is given by the mouth (stomach ingestion), by inunction, by fumigation, and by hypodermic injection. As a routine treatment medication by the mouth is the one most used,

and is suited to the habits and tastes of patients in this country; other methods are of great and even of more lasting benefit.

In assuming the charge of a case of syphilis the surgeon must not be influenced in the slightest degree by the dicta of those observers who divide the disease into two great classes—the mild and the severe—and base their therapeutics on that assumption. There are no precise data in the early stages by which a mild or severe course may be positively predicted, consequently all cases require an active, vigilant, painstaking, and conservative treatment. As time goes on the indications for greater or less activity of dosage will be very clear.

The necessity for an active, energetic treatment being conceded, the next questions are how to use the therapeutic agent, and for how long. Let us, for the sake of clearness, consider the last question. Whereas in former years mercury was given in large, even enormous, doses, it was only thought necessary to use it for a limited period, say of six months or a year. Now we use it in smaller doses and for long periods.

The duty of the surgeon being to care for a patient during two and a half, and even three or four, years, he must so administer the remedy that its action is constant and its result curative. Like all drugs, mercury when given for long periods loses its efficacy and influence over the syphilitic diathesis and its lesions. A condition of tolerance is induced by the continuous ingestion of the drug, and after a time it ceases wholly to be a therapeutic agent and often to have any effect, certainly none which is beneficial. Further, in syphilitics (I will not say what it does in dogs, rabbits, or objects of experimentation) it very commonly produces a condition of anæmia and debility (often even when the body is fat and flabby) and perhaps a low grade of gastro-intestinal irritation. I constantly see patients who come of their own accord or are sent by their physicians who have been treated continuously and *without any intermission* for one, two, or more years with mercury, and who still have some syphilitic lesion which refuses to disappear—perhaps dermal, osseous, or articular, or even cerebro-spinal or visceral. These patients, and very often their physicians, cannot understand why it is that a treatment so constant and energetic, and in most cases so conscientiously administered, should be productive of such unsatisfactory results. The answer to the question is very clear and simple: They had used mercury long after it had ceased to be a therapeutic agent, long after it had lost its influence over the syphilitic diathesis; and, strange to say, some had escaped without serious injury, but in others the chances of cure had been materially jeopardized or rendered very remote. I have seen, during a period of many years of observation, so much annoyance, so much trouble, misery, and even disaster, result from this method of using this incomparable remedy, and have become so convinced of the seriousness of the subject, that I feel that I must raise my voice against it as being an irrational and even mischievous treatment—a perversion of one of the greatest therapeutical blessings which we possess.

At the commencement of mercurial treatment it is important that the condition of the mouth, gums, and teeth should be examined and all abnormalities removed. The condition of the stomach also requires attention. Then a pill containing one-fourth or one-fifth of a grain of the green iodide of mercury or one-half grain either of the tannate or

the thymo-acetate of mercury may be ordered, to be taken three times a day. For this purpose the gelatin-coated pills of our prominent druggists or the tablet triturates may be prescribed in preference to certain French sugar-coated granules, which are frequently so hard that they are insoluble in the stomach. A favorite prescription with me is the following:

℞. Hydrarg. protoiodidi,	gr. vj–vij;
Ferri et quininæ cit.,	ʒiss;
Ext. hyoscyami,	gr. vj.—M.
Ft. pil. xxx.	

My experience and observation teach me that those cases of syphilis do the best that are vigilantly and energetically treated from the date of secondary manifestations for two or even three months. In my judgment this period is the crucial one in the history of the case, and according as the disease is thoroughly modified and acted upon at this time, so are the chances for future immunity proportionately great. It seems to me very probable that much of the late rebelliousness, and even malignancy, of syphilis is due to the fact that the newly-formed infecting granulation-cells and the concomitant subacute inflammation induce in tissues and organs, particularly delicate ones, structural and nutritive changes which predispose them to subsequent low grades of inflammation and cell-increase, besides a tendency to a repetition of the essential syphilitic process. We see this malign and subtle influence in the cerebro-spinal centres, in the tissues of the eye, in the viscera, and in the skin. This condition may be classed as a predisposition engrafted by syphilis to future cell-changes, hypertrophic or degenerative. The practical lessons to be drawn from the well-known clinical facts outlined here are, that every effort should be made to destroy the young, rapidly-proliferating cells of the active diathesis, to remove them as quickly as possible from the parenchyma of organs and tissues before they shall have time to induce these subtle but often most dangerous structural changes. Very many of the cases which are spoken of as not doing well under a systematic mercurial course are those in which the disease has not been profoundly and persistently acted upon in the early months. In proportion as a systematic and vigorous mercurial course is entered upon late, so is it more and more heavily weighted in its action. Mercurial treatment covering the first two or three months of the disease is, in my judgment, far more salutary and effective than a course extending over six or eight months instituted later on.

In general, it will be found in adults that three-fifths of a grain of the green iodide are not sufficient to make a perceptible impression on the lesions. It, however, is a good dose to begin with. By it the tolerance of the drug may be gauged and its remedial action estimated. It may with benefit be increased to four-fifths of a grain, and even a grain, daily, slowly or abruptly. In the vast majority of cases one grain or one and a half or two grains of the drug daily, in divided doses, will be amply sufficient. Should the severity of the symptoms and the intensity of the diathesis not be modified by these doses, it is well not to increase them, but to substitute the inunction method or hypodermic injections,

and thus spare the stomach. In uncomplicated cases such a profound effect is usually produced by an eight or twelve weeks' course that the medicine may be stopped. Then it is well to allow three, four, or six weeks to elapse without the administration of mercury, in which interval tonics or even the iodide of potassium may be given. Then the mercurial should again be used, since the system will once more be virgin to its influence, and its effects will be heightened. After eight weeks or even more of watchful energetic medication, another cessation of mercurial influence should be observed for a month or six weeks, when again it may be renewed. In this way a series of successive and efficient treatments are kept up, and the drug is held well in hand, producing therapeutical effects and not degenerating either into a toxic or an inert agent. The moral effect of the discontinuance of the ingestion of the drug upon the patient is very great and salutary. Patients weary of the seemingly interminable dosing of the continuous treatment, which is often irksome and sorely trying. In the intervals of repose they cease to consider themselves sick, and have the opportunity of judging their condition when freed from drugs.

It is necessary to clearly bear in mind the fact that the green iodide of mercury is in general only potential and curative in the early months of syphilis, and that later on it cannot be relied upon as a safe remedy, particularly if the case is one of any gravity.

My preference is to use this mouth treatment for a few weeks or less and then to put the patient on the inunction treatment which can be interrupted or replaced by mercury by mouth injection.

We should carry out the inunction treatment in a systematic, thorough, and minute manner. To this end I divide the body into eleven subdivisions, each of which is to be submitted to its own mercurial friction. They are as follows:

1. The neck and head.
2 and 3. The arms, palms, and axillæ.
4 and 5. The legs and soles.
6 and 7. The thighs, with groins and Scarpa's triangle.
8 and 9. The breast and abdomen.
10 and 11. The back from the root of the neck to lower part of the gluteal region.

In non-hairy persons there is little trouble in anointing the neck. In those whose necks are densely covered with hair we may be forced to confine the inunctions to the parts not covered. In urgent cases and where the lesions are copious it is necessary to have the hair clipped or shaved. If there are scalp lesions, or any in the beard, an ointment composed of white precipitate 30 grains and vaseline 1 ounce may be used freely. In this case it may be well to make the regular dose of mercurial ointment used elsewhere on the neck smaller. Prior to rubbing the ointment into the scalp and beard shampoos and antiseptic lotions should be used.

It is important that the whole surface of the arms should be acted upon in a vigorous manner. If there are any lesions of the palms, these parts should receive careful attention, and in any case it is well to anoint them several times during the treatment. It is most important to bring the ointment into contact with the contents of the axillæ; and this can

be done with impunity, provided care is taken that the parts are brought into an aseptic condition.

The legs and the soles should be well rubbed with both hands, and any lesions upon the latter parts should receive especial attention. In like manner the thighs should be treated, and the groins and the surface over Scarpa's triangle should be firmly rubbed for a sufficient time. If the ganglia in the groins are unusually swollen, it may be necessary to apply a layer of mercurial ointment on lint or one of the mercurial plasters. Great care must be exercised to keep the ointment from the scrotum.

Sometimes the inunctions produce irritation upon the breast and abdomen, and the method is pursued with difficulty. Under these circumstances, all means toward the avoidance of dermatitis and follicular inflammation should be adopted.

Patients rarely have any difficulty in administering to themselves inunctions upon the buttocks, but it is impossible for them to reach their backs. Therefore it is necessary to get outside aid, which in most cases I have found possible. By this method the whole body is treated in eleven séances. In many cases, when we use from 35 to 45 grains of the ointment for each rubbing, we can give the whole series of eleven on successive days. But, as I have said before, we can never be positive that we can do so; therefore the patient must be watched and questioned each day as to his condition. In this way we feel our way along, and continue or suspend the inunctions as the indications of the case teach us.

In giving a regular treatment by inunctions it is well to omit them for a few days, according to the indications, and then to go over the same ground again. In a systematic treatment we may give from fifty to eighty, or even a hundred, inunctions with proper intermissions, and then it is well to desist for a short or long time. In ordinary cases, where the inunction method is used as a regular mode of treatment, it may or may not be necessary to administer the iodide of potassium at the same time. In most cases it will not be necessary to employ a large dose of this salt. But in old and untreated cases it will be necessary to use stronger doses of the ointment, perhaps employ them more uninterruptedly, and combine them with large doses of the iodide given internally.

It sometimes happens that we desire to keep up a mild mercurial action, and the circumstances of the patient will not admit of the employment of frictions. In these cases the ointment may be spread over the body quite freely upon a canton-flannel belt, which may be worn around the body. In these cases of enlargement of the spleen, tenderness over the liver, with or without jaundice, pain in the chest (pleuritic or resembling angina pectoris), and in swollen and painful joints, these mercurial bandages may be employed with much benefit. This method is also useful in the treatment of syphilitic infants and children.

Though the inunction treatment is uniformly potent and beneficial, it has its drawbacks and complications. These are—1, dermatitis and follicular inflammation; 2, stomatitis and salivation; 3, digestive disturbances and intestinal complications; 4, sleeplessness; 5, inanition and

exhaustion; 6, tendency to congestion of the head, heart, and lungs; 7, tendency to fever and perspiration; 8, pain in the bones and joints. Though this list looks rather formidable, in actual practice the cases are few in which it is necessary to abandon the treatment or in which modifications and expedients fail to smooth matters over.

With careful antiseptic attention to the condition of the skin, and with the employment of fresh and pure ointment, we rarely encounter such an amount of inflammation in it that the patient is made to suffer or that the treatment is curtailed. Zinc ointment, Lassar's paste, and dusting powders, with protective layers of cotton, are very beneficial in the prevention of dermal inflammation.

Under the older system of inunction, when a larger quantity of blue ointment was employed, it was not uncommon to find mouth and throat lesions. When, however, the treatment is carried out on the lines heretofore indicated, the occurrence of salivation will be rather rare. Mouth lesions from inunction are similar to those produced by the internal use of mercury, with the exception that their onset is more sudden and abrupt and their severity greater. It is therefore necessary to follow the directions already given in the matter of attention to the teeth, mouth, and throat, to prevent salivation. It is also well to make the patient rinse the mouth well with solutions of chlorate of potassium and alum, and also with a mild solution of sugar of lead and acetate of alumina in peppermint-water. This precaution is particularly necessary when for any reason we are compelled to push the treatment.

Very often a reduction of the dose or its temporary suspension will cause the disappearance of irritability of the stomach. The trouble should also be treated symptomatically. In like manner, intestinal irritation should be treated, and very often much benefit will result from a full dose of castor oil.

In some cases sleeplessness is but an ephemeral symptom. It may persist and necessitate a suspension or diminution of the treatment. The bromides, sulphonal, phenacetin, and perhaps morphine and choral, may be temporarily resorted to, but always under the physician's knowledge and full direction. It is better to abandon the method than use any of these drugs for a long time.

In women particularly, a feeling of exhaustion and inanition, perhaps with digestive disturbance, may complicate the inunction treatment. The usual expedients of lowering the dose, of allowing intervals of repose, and of administering tonics, should be resorted to. If, after a conscientious trial of the method, these symptoms continue, it must be given up.

In cases, particularly uncomplicated ones, treated from the beginning there are usually no perceptible secondary or tertiary stages. The secondary stage is entered upon, the disease is systematically attacked, and, excepting perhaps a few ephemeral and trifling manifestations upon the skin or mucous membranes (and they are largely produced by extraneous irritation, friction, coaptation of parts, and want of cleanliness, smoking, etc.), he (or she) sees no further developments. The treatment, however, should be kept up for the specified periods.

In untreated and insufficiently treated cases we find the merging of the lesions into the tertiary type, and then the indication is to combine a

mercurial preparation with the iodide of potassium, commonly called the mixed treatment. Blue pill, gray powder, and calomel are deservedly passing into disuse. They are even to-day looked upon as promptly efficient agents, but they can always with advantage be replaced by mercurial inunctions or hypodermic injections. The blue pill has never commended itself to my favor. When it is given in small doses it does nothing whatever, hence is considered mild; and when it is given in sufficient quantity one never knows how soon severe salivation may be induced. The person who takes it is in continual jeopardy. So is it with calomel.

The tannate of mercury, as before mentioned, is an efficacious preparation which does not produce much gastro-intestinal irritation. The stated dose, one grain thrice daily, has been proved in my experience, as a rule, too large. It should be given in doses of half a grain three times daily, and increased if necessary. The carbolate, salicylate, and alaninate of mercury are recent additions to our armamentarium.

The following combinations are of much value:

℞. Hydrarg. biniodidi, gr. j–ij;
Potassii iodidi, ʒss–ʒj;
Syr. aurantii cort., ʒiij;
Aquæ, ʒj.—M.

One teaspoonful three times a day, an hour after eating, in a wineglass of water.

℞. Hydrarg. bichlor., gr. j–ij–iiij;
Potassii iodidi, ʒss–ʒvj–ʒj;
Tr. cinch. comp., ʒiiiss.
Aquæ, ʒss.

To be taken in the same manner as the foregoing.

When the lesions are of the brain, spinal cord, viscera, bones, or the connective tissue, the iodide of potassium or of the sodium may be used alone or in combination with the inunction method. (For further particulars as to the use of the preparations of iodine see Taylor, on *Venereal Diseases*, 1895, pp. 848 *et seq.*

Vegetable and ferruginous tonics, preparations of the hypophosphites, cod-liver oil, peptonizing agents, and all remedies tending to increase the strength and improve nutrition should be employed in combination with the specific medication. As an adjuvant tonic erythroxylon coca has proved a very valuable agent in my hands. It is best given in the form of fluid extract, but, unfortunately, many of the extracts in the market are inert. One of the most trustworthy preparations is that known as the "Mariani," which is really a fluid extract. The following are useful formulæ:

℞. Fl. ext. erythrox. cocæ, ʒij;
Tr. cinch. comp.,
Tr. gent. comp., āā. ʒj.—M.

Two teaspoonfuls in a wineglass of water three times a day, after meals.

℞. Fl. ext. erythrox. cocæ, ℥ij;
Tinct. gent. comp.,
Tinct. cinch. comp., āā. ℥j;
Elix. calisayæ, ℥iv.—M.
One tablespoonful three times a day in water, after meals.

℞. Ferri et quininæ cit., ʒiij;
Fl. ext. erythrox. cocæ, ʒij;
Tr. gent. comp., ʒiss;
Tr. nucis vom., gtt. cc;
Aquæ, ʒss.—M.
One teaspoonful in a wineglass of water three times a day, an hour after meals.

Zittman's decoction may be used in late and obstinate lesions.

Hypodermic injection in syphilis constitutes a treatment of utility and emergency. It can never be used as a routine treatment, for the reason that there is not sufficient extent of tissue on the body to fulfil its requirements. Then, again, the transitory or more or less permanent soreness and tenderness left by the injections, the indurated plaques and nodules, and deep abscesses, are powerful contraindications.

This treatment may be employed in the secondary stage, where other treatments are contraindicated, since it combines the advantages of smallness of dose, rapidity of action, and the absence of the local and systemic drawbacks incident to stomach ingestion of mercury.

An experience of twenty years with this treatment has convinced me that the best preparation is the bichloride of mercury in doses of one-eighth to one-twelfth of a grain dissolved in ten drops of water. All sorts of fanciful preparations have been proposed for the injections, looking toward absorbability and absence of local reaction (see Taylor on *Venereal Diseases*, 1895, pp. 871 *et seq.*), but they have, as a rule, been more appreciated by their introducers than by others. The injections should be made every day or every second or third day, according to indications, with the observance of thorough antisepsis and great care and slowness in the performance of the operation.

The revival of Scarenzio's method of calomel injections, which I saw tried in Charity Hospital in 1866 by my late associate, Dr. Bumstead, and found wanting, has not, to my knowledge, extended in a practical manner in this country. These injections (the vehicle being oil or glycerin), as practised by the advocates of to-day, are made usually deep into the muscles or connective tissues. The idea is to establish reservoirs of mercury in various portions of the body from which from time to time minute quantities of this beneficent drug may escape and pass into the circulation. Seeing that in many cases, notwithstanding the careful elaborateness of the technique, the injected spots become the seats of abscess, the treatment often degenerates into the establishment of scattered pus-producing foci in the body.

Mercurial fumigation is an efficient method of treatment and one of utility or emergency which can often be employed with great benefit.

Local Treatment of the Syphilides.—Much aid is often afforded

by direct treatment of the syphilitic lesions. A number of formulæ used in private and hospital practice will be given.

The erythematous syphilide may sometimes remain persistently on exposed portions of the body, and be both disfiguring and compromising. In such cases mercurial fumigations are often of much value. The following ointments may also be used:

℞. Hydrarg. precip. alb., gr. xvj;
Ung. aq. rosæ, ʒj.—M.

℞. Hydrarg. precip. rub., gr. xx;
Pulv. camph., gr. x;
Ung. aq. rosæ, ʒj.—M.

In very obstinate cases the following may be kept on as continuously as possible:

℞. Ung. hydrarg. fort.,
Ung. zinci oxid., *āā.* ʒj;
Acid. carbol., gr. xx.—M.

These ointments should be rubbed into the skin as vigorously as possible without producing dermatitis.

The following lotion may be used upon the face:

℞. Hydrarg. bichlor., gr. ij–iv;
Ammon. muriat., gr. x;
Aq. coloniensis, ʒiij;
Glycerinæ, ʒij;
Aquæ, ad ʒiv.—M.

It may be freely sponged on the parts or lint soaked with it may be applied to them.

The persistent forms of the papular syphilides may be removed by full baths composed of corrosive sublimate ʒj to ʒiv, with an equal quantity of muriate of ammonia in thirty gallons of very warm water. Papular syphilides of the palms and soles should be promptly attacked by an ointment composed of equal parts of mercurial ointment and vaseline. Where there are many papules, and much concomitant infiltration of the parts, the following ointments should be used:

℞. Ung. hydrarg. fort., ʒiij;
Bals. Peru., ʒij;
Ung. simpl. or vaseline, ʒiss.—M.

These ointments should be rubbed into the skin well, and if possible retained by gloves, those made of India-rubber by preference.

In cases of much infiltration with hyperæmia the following are very beneficial:

℞. Ung. hydrarg. fort., ʒij;
Ung. diachyli, ʒj;
Bals. Peru., ʒj.—M.

Chronic scaling papular syphilides of the body may be removed by using

℞. Chrysarobin., gr. x–xx;
Vaseline, ℥j.—M.

To be used after a warm alkaline bath, and care being taken to protect the eyes and perhaps the face.

Chronic scaling syphilides of the palms and soles may be benefited by the following:

℞. Acid. salicylic., ʒss–ʒj;
Ung. diachyli, ℥j.—M.

℞. Acid. salicylic., ʒj;
Chrysarobin., ʒss;
Ung. aq. rosæ or vaseline, ℥j.—M.

To be painted on occasionally.

Hypertrophic papules and condylomata lata may be washed with one part of Labarraque's solution and eight parts of water, and then dusted with calomel; or, after careful cleansing, they may be sprinkled with

℞. Acid. salicylic., ʒj;
Acid. boracic., ʒiij;
Cretæ præcip., ℥j.—M.

℞. Acid. boracic.,
Iodoformi, āā. ℥ss.—M.

Ulcers left by early and late syphilides should be carefully washed and cleansed, and if possible immersed in very hot water, and then dusted with iodoform or iodoform and precipitated chalk in equal quantities. When large surfaces of ulceration are present affusions of a warm- or hot-water solution of bichloride of mercury (gr. j to ʒxxxij) should be applied. It may be necessary to touch each ulcer with a solution of nitrate of silver (gr. x–xx to ℥j aq.) or with equal parts of carbolic acid and glycerin.

Serpiginous ulcerations require constant care and perhaps frequent mild cauterization of the ulcerating periphery. Iodoform may be used with advantage, but if the surface is large the surgeon must be on the lookout for toxic symptoms. The following lotion may be applied:

℞. Ung. hydrarg. fort., ʒiij–ʒvj;
Ung. zinci oxid.,
Ung. diachyli, āā. ℥j.—M.

Gummatous ulcers require much care and attention. When there is a foul, uneven necrotic base the careful application of (*a*) caustic potassa ʒij, water ʒj, or (*b*) of a sixty-grain-to-the-ounce-of-water solution of nitrate of silver, or (*c*) equal parts of carbolic acid and glycerin, should be made as often as necessary. Then the surfaces may be dusted with iodoform or with

℞. Iodoformi, ʒij;
Bismuth. subnit., ℥j.—M.

Sterilized sand may also be advantageously employed, particularly in very deep and extensive ulcers, after carefully and sparingly dusting them with iodoform.

In all cases of ulceration rest and the recumbent position should be ordered; the parts after any application should be covered with some antiseptic dressing, and the whole carefully and firmly bandaged.

In the treatment of hereditary syphilis the dose must be regulated to the age of the patient. When the disease is active mercury with chalk may be given to infants without fear of stomach disorder. This drug should be given for several months with intervals of rest. In gummatous and bone lesions this mixed treatment is very efficacious.

The Chancroid.

The chancroid is a local contagious ulcer of the genitals, inflammatory in its nature and very destructive in its course. It never under any circumstances leads to syphilis nor any form of systemic infection. Its action is purely local to the parts upon which it develops and to the lymphatic vessels and ganglia in immediate anatomical association with those parts. Under certain circumstances chancroid becomes serpiginous, creeping from its original focus and attacking and destroying parts beyond, or, beginning in a chancroidal bubo, it runs a chronic, deeply destructive course over the pudenda, thighs, abdominal walls, and in very severe cases ends in death. Like gonorrhœa, chancroid is in very many cases, particularly among the lower, ignorant, and uncleanly classes, an essentially venereal disease, having its origin in sexual contact and its lesions being sharply limited to the genitalia. The vehicle of contagion of the chancroid in clinical practice is the secretion of a chancroid, of chancroidal lymphangitis, of a chancroidal bubo, or of a serpiginous chancroidal ulcer. Besides these secretions, inflammatory pus and pus resulting from active irritation of syphilitic lesions are also capable of producing chancroidal ulcers *de novo*, the person from whom the contagion is derived being perhaps free from actual chancroids at the time.

Inoculation experiments have shown that the contagious property of chancroidal pus is contained in the corpuscles, since its filtered serum has been found to produce no reaction upon the tissues. Upon this fact the hypothesis has been based that chancroid remains a local disease for the reason that its pus-cells are confined to the nearest lymphatic ganglia and do not enter the circulation. This may be taken as a fair specimen of the indiscriminate generalization which has been indulged in regarding these ulcers.

A marked peculiarity of the chancroid is its amenability to reproduction upon its bearer. This may be demonstrated by experimental inoculations by means of minute superficial incisions or abrasions, and is very commonly seen in auto-inoculations, particularly in women. Our knowledge of the inoculative power of the chancroid, and of the varying vulnerability of the skin thereto, largely depends upon the experi-

ence of those who years ago practised syphilization for the cure of syphilis, using therefor chancroidal pus and pus derived from irritated syphilitic lesions. It was proved that these forms of pus produced ulcers having all the characteristics of chancroids in a long series, but that in time their power seemed to wane, since only aborted pustules were produced. The natural inference from the facts as observed was that auto-inoculations with chancroidal pus gradually decreased in activity with the increased repetition of the process.

This decrease in the activity of the ulcerations on the skin is essentially due to the waning power of final decadence of the pus-microbes. In mucous membranes, however, the succulence and vascularity of the tissues seem to stimulate the vitality of the micro-organisms, and in these structures they luxuriate for longer periods. As a rule, tissues chronically affected by chancroidal ulcerations become more and more immune to its action and are less and less affected by the destructive process.

After a period of quiescence tissues which had failed to respond to the irritant action again became susceptible to the influence of chancrous pus. The practical application of this fact is that a man or woman may have an indefinite number of chancroids during life.

Various statements have been made as to the durability of chancroidal pus when transferred from the body. Thus, Ricord says that he kept it in sealed tubes for seventeen days, and then found it active, and Sperino claims that by means of a lancet upon which this secretion had dried seven months later he produced chancroids. The late Prof. Boeck of Christiania, whose experience in chancroidal inoculations was greater than that of any man before or since his day, assured me that chancroidal pus lost its irritant qualities in a few days after drying; and I personally saw my late colleague, Dr. Bumstead, fail at Charity Hospital to make successful inoculations with chancroidal pus which had been dried on glass slips for twenty-four hours. These facts would seem to indicate that the micro-organisms of chancroid only have a feeble vitality when removed from the human body.

When greatly diluted in water this form of pus loses its power, which is probably destroyed in any menstruum in which its corpuscles become disintegrated.

According to general testimony, chancroidal ulcers may be transmitted by inoculation to the lower animals. This fact, first evolved during the period of obscurity of the chancroid, and made much of by the dualists in their arguments, is pertinent in emphasizing the point of difference between it and syphilis, which is not communicable to animals, but, in the present status of this question, it is no longer essential or of any practical value.

Modes of Contagion.—Chancroidal contagion takes place most commonly in the lower classes by actual contact, the pus being transferred from one person to another in the act of coitus or in some other intimate mode of direct transfer. This method is called "direct contagion." What is known as "mediate contagion"—in which the secretion is transferred by means of the fingers, by towels, utensils, and instruments—may also occur, but much less frequently.

It is probable that chancroidal inoculation in sexual intercourse in

many instances takes place by means of more or less well-marked erosions, abrasions, tears, and rents in the mucous membrane, and even on the surface of herpetic vesicles. It is also fair to assume that the balano-preputial mucous membrane, with its delicate epithelium and its rich and very superficial capillary system, especially as it is subject to the heat, moisture, and maceration incident to the nature and structure of the parts, may be eroded by the irritating pus and become the seat of chancroids. Clinical observation certainly warrants the view that this secretion may lodge in the ducts of the sebaceous follicles of the integument of the penis, and there produce ulceration. The impunity with which surgeons whose fingers are intact handle chancroids and their sequelæ proves that the epidermis of the skin is to an extent impervious to the action of the pus. It is important to remember, however, that we frequently see on uncleanly patients chancroidal pus escape from the genitals and remain for a more or less long time upon the integument and there produce typical ulcers in the hair follicles. In this case also it is fair to assume that contagion has taken place through the irritant action of the pus in the follicular openings. It is also certain that prolonged lodgement of chancroidal pus upon the fingers, particularly in the region of the sulcus of the nail, will be followed by ulceration.

While in syphilis mediate contagion is quite common, in chancroid it is quite rare. Instances in which patients have transferred chancroids by means of their fingers or nails to other portions of the body through scratching or other modes of transference have occurred in my experience as well as in that of others. I have also seen chancroidal contagion result from the carelessness of a surgeon in the operation of circumcision, and a simple bubo converted into one of the chancroidal variety by the surgeon operating upon it without having cleaned the bistoury with which he had just incised a chancroidal bubo.

Chancroidal pus smeared upon a water-closet seat may possibly be transferred to the genitalia or perigenital region of another, though I have never seen or heard of such an accident.

Occasionally we see men suffering from chancroid who have cohabited with women upon whose genitals no ulceration can be discovered; and the explanation of the case formerly very generally accepted was that in the vagina chancroidal pus had been deposited by one man and taken up in coitus by a second one, who became contaminated, while the woman thus freed from the pus escaped. The case related by Ricord, in which during a husband's short absence his friend, suffering from chancroids, had connection with his wife, who shortly after cohabited with her husband, who contracted chancroids while she escaped, is so full in detail as to be convincing.

Frequency.—The collated experience of those who see large numbers of cases of venereal diseases goes to prove that the frequency of occurrence of chancroid is largely dependent upon the class of cases observed. It is found more commonly in the lower classes, and it becomes rarer and rarer relatively to the syphilitic chancre in proportion as we rise in the social scale. Fournier explains this condition by assuming that men of the lower classes mostly cohabit with old prostitutes long ago syphilitic, and then only subject to chancroid, while among the upper classes younger women, who are just acquiring or have just acquired their expe-

rience in syphilis are the ones in demand. Our knowledge of the nature of the chancroidal ulcer is based upon clinical observation and experimental inoculation. It does not have a special specific virus, and the ulcer may be readily generated *de novo* at the will of the experimenter from various and the most different sources. Observation and investigation have shown that while the chancroid may be, and very commonly is, derived from a previous chancroid, a chancroidal bubo, or chancroidal lymphangitis, it may also originate in the pus derived from irritated lesions of syphilis and from irritated simple lesions in syphilitic subjects, and also in simple pus, particularly when originating in active or intensely irritated lesions.

In older works the origin of chancroid is always associated with sexual contact, and nothing is said of the development of the disease *de novo*. The truth is, that clinical observers were held in thraldom by the doctrine of the absolute specificity of the chancroid, and they undoubtedly failed to rightly interpret cases in which men presented true chancroids, yet who had been infected in the sexual act.

In very many cases, undoubtedly, chancroids are derived during sexual intercourse, one party being affected with this active form of ulceration. This form of transmission of the disease is well and generally known. It is transmission by direct descent. But it must be clearly understood that chancroids may be found on the penis of a man and that examination of the woman with whom he cohabited may show her to be free from these lesions. In other words, it is not safe to say to a man suffering from chancroids that the woman with whom he cohabited undoubtedly had chancroids.

Pus from irritated simple erosions of the cervix may sometimes cause chancroids in men.

Many cases of chancroid are thus developed through non-syphilitic women in whom, owing to various causes, an exacerbation has taken place in some lesion of the genitals that previously was innocuous, and which then gave forth an active form of pus. It follows, therefore, that we should be guarded in the cases of suspected wives and mistresses as to what we say to husbands or lovers that are unlucky enough to become affected with ulcers of the genitals in intercourse with the former. Otherwise much harm may be done and innocent women may be cruelly wronged.

It is far from uncommon to observe chancroids in a man contracted in intercourse with a syphilitic woman who has no specific lesion of the genitals, but who suffers from a purulent vaginal secretion. In these cases the simple inflammation of the syphilitic woman gives issue to pus rich in pyogenic microbes. This, again, is an illustration of the statement that men may gain chancroids from women whose genitals are free from these lesions. I have many times, by means of confrontations, conclusively convinced myself of this mode of origin of chancroids.

Then, again, I have seen many instances, in the lower class of patients, in which men have cohabited with impunity with women the victims of an old and extinct syphilis, but who suffered from chronic chancroids. In these cases the ulcers had become old and inactive and they ceased to secrete a dangerous pus.

Chancroid being classed as a venereal disease, the physician instinctively thinks that a given ulcer that is presented to him must of necessity have originated in sexual contact. In many cases this supposition is not correct, for chancroids may, as we have seen, originate in some subjects *de novo*. In other words, it is not very uncommon to see chancroids in men who have had no sexual exposure whatever, such lesions being perhaps due to some inherent peculiarities of their tissues, to some diathetic condition, or to debility, or to some contamination with particles of dirt that have lodged upon their genital organ. This mode of origin of the chancroid has been conclusively demonstrated to me by very many cases in which herpetic lesions become transformed into actively destructive chancroids. Such cases are far from rare, and if the practitioner will carefully interrogate the patients that come to him suffering from chancroids, he will in many instances find that there has been no exposure within the time required for the development of these lesions, and he will convince himself beyond all doubt that the ulcerative lesions are due to some unknown source of contamination of herpetic vesicles, of chafes, abrasions, or fissures. I have among my notes many cases illustrating the origin of chancroid in all of these lesions and traumatisms. The chancroid in these cases is simply an evidence of wound-infection, and is really a septic ulcer.

It is very important to understand the relation of an active syphilitic infection to excoriations, chafes, abrasions, and fissures about the genitals, male and female. In the first and second years of syphilis more especially, and in some instances at later periods, we find in many cases the simple lesions just enumerated become transformed into ulcers having every feature and characteristic peculiar to chancroids. Cases presenting these features are frequently very puzzling, and it is important that their nature should be clearly understood. The citation of a case is therefore warrantable: A gentleman, aged twenty-eight, had been syphilitic less than a year, and, though commenced rather late, specific treatment was doing well for him. He presented four typical chancroids on the inner aspect of the prepuce, which appeared twelve days after intercourse with a woman who, under examination, was found to have a simple leucorrhœa. The gentleman had for years, at irregular intervals, suffered from herpes progenitalis, which had always healed promptly under simple treatment. He was therefore much impressed with the fact that in two such attacks which occurred since his infection with syphilis the excoriations had developed into unhealthy-looking and destructive ulcers, which were difficult to cure.

In this case we find a condition very frequently observed in syphilitics. Simple inflammatory lesions of the genitals become converted into typical chancroids—or, as we may say, wound-infections or septic ulcers—undoubtedly as the result of contamination with pyogenic microbes, the source of which is a mystery. Lesions thus produced often display great virulence in consequence of the activity of the local infective process (staphylococcus and streptococcus infection), which seems to reach its acme in syphilitic tissues, particularly when in the infection is not very old. Pus taken from these chancroids in syphilitic subjects will, as a rule, be seen to possess great potentiality in the extent and persistence of the ulcers and in the power that

it possesses of producing by inoculation similar lesions for many generations.

In some of these cases of chancroid that develop *de novo* in syphilitic subjects, contamination of the inguinal ganglia takes place by direct lymphatic absorption. As a result we have two forms of bubo—the irritative, which may be aborted, and the virulent, which leads to abscess. It is very probable that in the tissues of syphilitic subjects the pyogenic microbes find a most favorable nidus. The inflammatory process to which they give rise is often very active, and the resulting pus, rich in microbes and their poisons or tissue-products, is very virulent and destructive.

What we call chancroid is the product of many varieties of pus derived from non-syphilitic and syphilitic subjects. It is therefore a hybrid, heterogeneous lesion, in all cases a septic ulcer, and in many instances simply an active form of wound-infection. This septic ulcer in some cases originates *de novo* from the contact of pyogenic microbes with a raw surface, herpetic or eczematous excoriation, a chafe, etc., sexual contact then having nothing to do with its development. As a general rule, this local infective process is more active in syphilitic than in non-syphilitic subjects. It follows, therefore, that so long as pyogenic microbes and tissue-predisposition exist chancroids will be found upon the mucous membrane and integument of the human race.

Chancroidal ulcers have no period of incubation, since the destructive action of the pus or of the pyogenic microbes begins at once, and the resulting lesion is apparent as soon as the morbid action penetrates beneath the epithelium. Thus, when this layer is thick the appearance of the chancroid may be delayed, and very often some time elapses during which the pus is entering a follicle. Constitutional conditions in many cases influence the rapidity of development. Chancroids on mucous surfaces develop much more quickly than upon the integument. Abrasions, excoriations, and fissures in the mucous membrane afford favorable doors of entry, and upon them chancroids develop with great promptness. In general, inflammatory action is very apparent within twenty-four hours after the implantation of the pus on mucous membranes, and within forty-eight hours, in general, the pustular nature of the lesion can be readily made out. In other cases the progress may be slower, and three or four days may elapse before the chancroid pustule is fully formed. These statements are based on the results of experimental inoculation, and are in the main correct. The statements of patients sometimes place the appearance of the chancroids after connection at much longer intervals, but they are so liable to errors of observation, and often are so careless of their persons, that very little reliance can be placed on their statements. The surgeon very often can form a more correct idea from the size and number of the lesions than he can from the patient's story.

By the aid of experimental inoculation and of clinical observation we are able to give a very clear description of the early appearances and course of the chancroid. In its course there are three stages—the active, the stationary, and the reparative.

Upon mucous membranes the very first sign of a chancroid is a minute yellow spot surrounded by a halo of intense redness, which

shades off into the surrounding pink color. If not ruptured, the yellow central spot grows larger and higher, and very soon a typical conical-shaped pustule is formed. Upon the integument the same yellow spot and red halo are present, and the pustular condition may be present or may be replaced by an ulceration. In most cases on mucous membranes chancroids very early lose their epithelial dome, which constitutes the pustule, and the typical ulcer is then seen.

The outline of a chancroid is usually either round or oval, according to the conformation of the parts upon which it is seated; but when developed upon a fissure or abrasion it may be linear or irregular. Irregularity of outline also results from the coalescence of a number of chancroids. On the prepuce and in the sulcus they are circular; about the frænum they frequently are oval; when developed partly on the glans and partly on the prepuce they are irregular, for the reason that the ulcerative process is more active on the former than on the latter. Chancroids at the orifice of the prepuce and at the anus have a tendency to follow the radiating fissures peculiar to these parts.

A comprehensive idea of the clinical feature of chancroids may be gained by a survey of Plate X. Figure 1 shows incipient chancroids on the inner lamella of the prepuce, while in Figure 2 a well-developed chancroid of the integument is portrayed.

Whatever the shape of the chancroid, the edges are sharply cut and abrupt, as if punched out. The whole thickness of the epithelium is destroyed, and it can be seen that though cleanly cut, as is the resulting lesion, the edges of it are slightly undermined, in some cases to such an extent that the tip of a probe can be carried circumferentially around the ulcer and under it. This feature of undermined edges is due to the fact that the soft subepithelial tissues are less resistant than the more horny epithelium. In addition to the undermined condition, the edges are frequently minutely uneven or jagged, as best seen by a magnifying-glass, showing that the destructive action takes place by minute radiating processes. Around the edge of the chancroid is an areola of redness which varies in depth and width according to the stage of the inflammation. This red halo extends *pari passu* with the ulcer. The floor of the latter is peculiarly uneven and worm-eaten in appearance, and in its early stage covered with a light yellowish pellicle composed of disorganized tissues and pus. With the growth of the ulcer this film becomes thicker and forms a bright or golden-yellow pseudo-membranous layer, which is shown with admirable fidelity in Figures 1, 2, 3, and 4 of Plate X. This membranous pellicle covering the chancroid is thrown into little uneven mammillations, which correspond to the minute rugosities, which cover the surface of the ulcer.

The secretion of chancroids is in the active stage quite abundant, and, while purulent, the pus differs from that of gonorrhœa. It is thinner in quality and usually of a brownish or rusty-brown tint, due to the admixture of small quantities of blood. This chancroidal pus under the microscope is found to consist of pus-globules, red corpuscles, and the detritus of tissues.

The underlying bed, as it may be called, of chancroids should always be attentively studied. It usually consists of ordinary inflammatory œdema, and is felt between the thumb and finger as a mass firm in con-

sistence midway between ordinary œdema and a furuncle. It is yielding to firm pressure, though not doughy, but has not the dense consistence of the true hard chancre. The œdematous infiltration of the chancroid is not very sharply limited, but becomes gradually lost in the surrounding tissues.

In the typical hard chancre the induration, on the other hand, is condensed and sharply circumscribed. This symptom, to a certain degree important in the diagnosis of the chancroid, is often much obscured by injudicious cauterization, particularly when the solid stick of nitrate of silver is vigorously used, and also when chromic acid, pure sulphuric acid, and indeed any very caustic application, is made. A similar misleading hardness is very often felt after active cauterization of herpetic vesicles, abrasions, fissures, and vegetations.

The duration of the period of activity of chancroid is so variable that it is really indefinite. It is influenced largely by the intelligence and efficiency of the treatment, the care and attention of the patient, and by his general condition and modes of life. Alcoholic indulgence is a prolific cause of chronicity and activity of chancroidal ulceration, and plethora tends to increase it. A very active life, much walking and physical exercise likewise tend to perpetuate the existence of these sores.

In general, chancroids exist in an active condition from two to four weeks, but they may be arrested sooner by treatment or they may thus continue for indefinite periods. The amount of destruction of tissues varies in different cases, in different localities, and in varying conditions. On the integument the ulceration is slow, and there is not the marked tendency to extension that there is on mucous membranes. In some instances the ulceration extends quite superficially over considerable surface. Then, again, the ulceration grows in extent by the fusion of a number of chancroids, as depicted in Figure 6 of Plate X., in which it will be seen that a large portion of the surface of the integument of the penis has been invaded. In Figure 4 an active chancroid is seen complicated by the development of another chancroid in the course of the lymphatics—called *bubonulus*—a feature first described by Nisbet.

The so-called stationary and chronic period of chancroids exists in many cases, owing to the apathy and inattention of the patient; and these circumstances have proved to us that after a varying time the intensity of ulceration in chancroids passes into a stage of quiescence, in which there is no marked tendency to destruction, and on the other hand, none to repair. A chronic chancroid, such as shown in Figure 5 of Plate X., all irritating influences being at a minimum, might thus remain for several weeks or months. This aphlegmasic condition may readily give place to exacerbation of the destructive action.

The stage of repair of chancroids is indicated by a number of changes in all the features of the ulcer. Perhaps the most noticeable one is a diminution of the inflammatory areola and a subsidence of the underlying œdematous infiltration. Then the grayish-yellow well-marked pseudo-membranous layer begins to disappear, and as it does healthy pink granulations spring up over more or less of the surface and the unhealthy pus begins to become laudable. The undermined edges lose their deep redness and gradually disappear and the ulcer becomes saucer-

shaped. Coincidently with this, healthy granulations make their way over the whole surface and push upward, gradually becoming even with the parts around. Then a delicate filamentous ring of epithelium begins at the place of the undermined edge, and gradually increases in width, at the same time closing over the site of former ulceration, until, in the end, full cicatrization is accomplished. In cases where the sores have been quite large points of cicatrization spring up in the centre, enlarge, fuse together, and meet the circumferential healing ring. These minute surface-spots of healing are well described by my late colleague, Dr. Bumstead, as follows: "Macerated by the discharge, it (the spot) has a whitish look and resembles a fragment of lint which has not been removed at the last dressing; but at subsequent visits of the patient it is found to be still present, gradually increasing in size until it becomes continuous at some portion of its periphery with the margin of the sore, and it thus contributes toward the final closure of the wound."

A remarkable feature of the chancroidal ulcer is its tendency, even in the reparative stage, to retrogress and assume all of the attributes of activity. In such cases, however, there is usually some well-defined cause for the exacerbation, such as carelessness, and particularly uncleanliness, sexual intercourse, or alcoholic excesses. A sore which has seemingly become of a simple nature rapidly takes on all of the chancroidal features, even to great destructiveness. This possible accident should always be remembered by the surgeon in holding his patient well in hand, even when the latter regards himself as virtually well. The possibility of contagion in the advanced reparative stage of chancroid should always be impressed upon the patient. With thorough cicatrization the chancroid is annihilated; without fresh contagion there is no relapse, such as we often see in true chancre.

Scars left by chancroids vary according to the size, depth, and situation of the ulcers, and are trifling or severe in proportion to the extent of the destructive process. They may be superficial, thin, and smooth, or they may be thick and deep, uneven, and traversed by fibrous bands of various sizes. At the margin of the prepuce following a chancroid they are usually hard and fibrous and produce more or less phimosis. When superficial, but extensive, as when following a chancroid on the glans, they are thin and smooth. Extensive chancroids of the balanopreputial furrow are usually followed by much destruction and an uneven fibrous cicatrix, often adherent to the corpora cavernosa. Chancroids of the frænum may result in a well-marked scar and more or less deformity. Chancroids producing phimosis and paraphimosis are followed by much destruction of tissue and by firm fibrous scars of varying shapes.

SEAT OF THE CHANCROID.—In the male chancroids are most commonly found in the sulcus behind the glans; on the inner surface of the prepuce; on and near the fourchette, particularly on the fossæ on each side of it; on the lips of the meatus and within the urethra; upon the sheath of the penis; on the glans; and, usually by auto-inoculation, on the scrotum, thighs, pubes, and anus. They occur on the finger by contagion from genital sores and upon the face by means of the fingers, and within the anus from pederasty. In women they are found at the introitus vaginæ; on the fourchette and vestibule and on the clitoris;

on the labia minora; within the vagina (rather rarely); on the os uteri; on the labia majora, and by auto-inoculation on the integument of the latter bodies; upon the perineum, inner surface of the thighs; on the hypogastrium and around the margin of and within the anus.

Chancroids are also common on other portions of the vulva and on the internal surface of the labia majora, where they occasion pain and difficulty in walking. Vulvar ulcers become much inflamed from the irritation of the urine and vaginal discharges, which likewise render them difficult of cure. Those situated at the meatus often penetrate the urethra for some distance, giving the orifice an infundibuliform shape, or, by destroying the posterior wall of the canal, throw its opening backward into the vagina. When attacked by phagedena the loss of tissue may result in great deformity and inconvenience.

The most simple form of chancroid is very shallow (see Fig. 1, Plate X.); the undermining of the edges is very slight, and the worm-eaten unevenness of the base very delicate. The condition may really be but the early stage of the ulcer, and appropriate treatment very soon brings about the reparative stage.

A form called by Clerc the "exulcerous chancroid" is occasionally seen. The sore is shallow and saucer-shaped, and the punched-out, sharply-cut edges are wanting. The floor is rather smooth and covered with a grayish-yellow film, and from it much pus escapes (see ulcer just behind the corona in Fig. 4). The two foregoing varieties are stages of development rather than different forms.

Upon surfaces where mucous membranes and integument meet, and upon the mucous membrane lining the labia majora and on the skin in the region of the genitals, rounded conical elevations surmounted by a minute pustule are sometimes seen. The pustule increases in size and forms an ulcer which presents a crater-like appearance, as sometimes seen in acne indurata. This lesion is called the *follicular* or *acneform chancroid*, and results from the destructive action of the pus, beginning in the hair or sebaceous follicles and accompanied by much inflammatory swelling.

What is termed the *ecthymatous chancroid* is always met with upon the integument, particularly upon the penis and those parts of the genitals of both sexes which are not macerated with perspiration or which are not in coaptation. This variety of chancroid resembles in many of its features chancroidal ulcers produced by inoculation. It begins as a small red spot, commonly around a hair-follicle, which increases rather slowly, with a small, more or less perfectly formed pustule in its centre. As the redness extends the pustule flattens down into a blackish-green crust, and thus may attain an area of nearly half an inch before its nature is suspected by the patient. Removal of the crust reveals a typical chancroidal ulcer, with the exception that the sharply punched-out and undermined edges are thicker, as they are composed of epidermis; the floor is deeper, corresponding to the thickness of the skin, and the base more markedly uneven and worm-eaten. The ulcer is usually slow in its course and secretes a large amount of pus, which constantly dries into a crust. Upon the integument of the penis or on the outer surface of the labia majora, where it quite frequently occurs, this chancroid is sometimes accompanied by lymphangitis and adenitis.

PLATE X.

Chancroids.

Diagnosis.—The chancroid may be mistaken for herpes progenitalis, exulcerated balanitis, ulcerated fissures and abrasions, hard chancres, mucous patches, ulcerating syphilides, and epithelioma.

When a number of herpetic vesicles are grouped on the genitals presenting their polycyclic outline, their shallow and not much ulcerated surface, with the history of antecedent pains, their diagnosis is easy. In cases in which there is much inflammation a doubt may exist, but while ulcerous herpes may extend deeper into the tissues, it does not, as a rule, like chancroid, extend peripherally by ulceration. Herpetic vesicles coalesce because they are so closely grouped; chancroids coalesce by peripheral extension and fusion with each other. A single herpetic vesicle may be mistaken for a chancroid, but observation of its course for a day or two will settle the question of its nature. The crucial test of auto-inoculation of the secretions will in the case of chancroid be followed by a similar lesion, whereas failure would follow in the case of herpes progenitalis. It must be remembered, however, that in uncleanly persons, in those whose vesicles have been injudiciously cauterized, in persons of poor fibre, in plethoric subjects, and those given to drink, herpes progenitalis often takes on features identical with those of chancroids. Indeed, they may be the starting-point of chancroids.

Exulcerated balanitis is commonly very readily recognized. Its lesions begin in patches much larger than chancroidal ulcers, usually with a history of inattention to cleanliness, or of phimosis, and their edges are not undermined, nor are their surfaces ulcerated or worm-eaten, but rather smooth and velvety.

Very frequently, patients, particularly men, are much exercised over traumatic fissures and abrasions. When such inflammation is present a reserved diagnosis may be made, but cooling applications will cure the simple lesion, whereas the chancroid will be only slightly improved. Water dressings and time will make the diagnosis between a simple lesion, a chancroid, or a hard chancre, the last of which these seemingly simple lesions often prove to be. This fact cannot be kept too prominently in mind.

Mucous patches may in a measure resemble chancroid if very much irritated, but it is an exceeding rarity to see them present and of the appearance of the chancroid. Usually their mode of development, size, situation, their well-marked salience, their configuration, peculiar color, and their coexistence with a history of syphilis or with syphilitic lesions point out their specific nature. It must be remembered that about the genitals of both sexes patches and condylomata lata are often much irritated and give issue to an irritant pus which is auto-inoculable.

In old syphilitics, both male and female, particularly those who are cachectic or broken down by dissipation, ulcers having all the characters of chancroids, but of greater depth, are not uncommonly seen. They have a soft base, are very often multiple, particularly in women, very sluggish in their course, usually accompanied by ganglionic reaction, but attended by a profuse purulent secretion. In some instances I have seen their pus produce other similar ulcers by auto-inoculation, and I have seen several cases in which their secretion produced undoubted chancroids in coitus. These ulcers in women are commonly attended with much œdema and cell-infiltration, and may exist months and years.

In somewhat rare cases they become phagedenic. In men, though occasionally very chronic, they are less formidable.

It is scarcely conceivable that chancroid can be mistaken for epithelioma, yet my colleague, Dr. Bumstead, saw in consultation a case in which this accident occurred. When it is considered that cancer and epithelioma do not begin as ulcers, but as small nodules and warty growths, particularly on parts the seat of antecedent chronic irritation, the diagnosis seems very easy.

Prognosis.—In the majority of cases the prognosis of chancroid is good. When intelligent and efficient treatment is instituted early, the affection is soon cured. Carelessness of the patient, dissipated habits, and excessive physical exercise render a prognosis less positive and assuring.

When phimosis or paraphimosis is present the outlook is more grave, since, unless the patient can be put under perfect control on his back, the progress of the case will inevitably be bad, and may result in more or less loss of tissue or deformity of the penis, may be complicated by severe hemorrhage, or result in phagedena or gangrene. Lymphangitis and buboes may be produced, which may lay a patient up for a long time, besides entailing upon him much suffering and misery. In such cases the immunity to systemic infection enjoyed by the patient is a source of much comfort to him. Chancroids of the meatus and urethra under unfavorable circumstances result in stricture.

In women the prognosis of chancroids is less favorable, even in mild cases, than in men. The difficulties of properly treating them, unless they remain in bed under the care of a nurse or in a hospital, are very great. The conformation of their parts, the presence of normal and abnormal secretions, the setbacks caused by menstruation and difficulty of retaining properly the dressings,—all tend to prolong the course of the ulcers. Further, women as a rule are not docile patients.

Young surgeons are prone to fear phagedena and gangrene in the course of chancroids. These formidable complications are usually not to be feared early in the course of these lesions. I have in private practice never seen them begin in uncomplicated young chancroid, though in armies, jails, and emigrant vessels, and among the squalid poor and drunkards, they often begin quite early. There is usually, in these cases, a history of injudicious treatment, particularly in the way of improper cauterization, of absence of treatment, and inattention on the part of the patient, or of inaccessibility of the ulcers in consequence of complications, such as phimosis or paraphimosis. The presence of complications should always render the prognosis more guarded, particularly in persons of poor fibre and in those given to drink.

Treatment.—Cauterization of chancroids has for its object their destruction and their transformation into simple lesions. To-day this treatment is not largely followed, owing to the tendency, which has increased within the past fifteen years, to limit it to certain cases. The agents now mostly used are nitric acid and carbolic acid. Carbo-sulphuric paste, Vienna paste, Canquoin's paste, acid nitrate of mercury, chloride of zinc, and solutions of caustic potassa are deservedly passing into oblivion.

It is of prime importance that patients suffering from chancroids should be as quiet as possible; that they should rest at every opportunity, should not attempt severe muscular exercise, nor walk, jump, dance, nor ride on horseback. Care should be taken that friction and pressure of the penis be avoided. Alcoholics should be uncompromisingly interdicted, and plain digestible food taken.

The most rigid attention to cleanliness and to keeping the parts very dry is necessary during the existence of chancroids.

Destructive cauterization is only applicable for chancroids in the early stage and before the ulcers become complicated by much œdema. Before using it—in fact, before making any application to chancroids—the ulcers and the surrounding parts should be thoroughly cleansed with soap and water, and then well irrigated with a very warm or hot solution of bichloride of mercury (1:2000). No chancroid should be thus treated which cannot be thoroughly exposed and afterward carefully dressed. The technique of applying the acid—and in most cases liquid carbolic acid answers every purpose—is very simple. The surface of the ulcer must be carefully dried, and then the acid thoroughly applied by means of a bit of absorbent cotton wound around the end of a wooden tooth-pick. Care must be taken that the undermined edge is thoroughly touched, but that none of the liquid escapes on the surrounding parts. Some authors recommend that the application of carbolic acid shall be preliminary to that of nitric acid, the former playing the rôle of an analgesic. In the vast majority of cases within the lines already indicated this double cauterization is wholly unnecessary. Such is the evanescent character of the pain produced by carbolic acid, which is soon followed by a sensation of coolness and numbness, that patients make scarcely any complaint from its use.

When the chancroidal film at the floor of the ulcer is rather thick it may be necessary to use the stronger caustic, nitric acid, which may be done in the manner just indicated; but it is always well to first apply a 10 per cent. solution of muriate of cocaine. By this means the patient suffers no pain, and the surgeon may be more thorough in his application. There is no necessity for the use of a long glass stopper or of a glass rod in applying nitric acid, since it can be done much more perfectly with the absorbent cotton on the end of a wooden tooth-pick. It is usually well for a few hours after these caustic applications to apply water dressing or lead-water on lint.

The actual cautery and Paquelin's thermo-cautery are very efficient destructive agents, but their use is greatly restricted in consequence of the dread inspired in the mind of the patient by them. Though the parts may be thoroughly benumbed by cocaine, few persons can avoid shrinking when they see the incandescent wire or cauterizer.

A word of warning is necessary against the use of the stick nitrate of silver, which unfortunately is largely used by the laity and many physicians, not only for chancroids, but also for simple fissures, erosions, and herpetic vesicles. This agent irritates, while it does not destroy; it intensifies the patient's sufferings, obscures the nature of the lesion, rendering diagnosis impossible, and produces so much inflammatory œdema in the lesion and around it that it is frequently mistaken for a hard chancre. Its use is to be emphatically condemned.

In this connection it is well to emphasize the fact that mercurial ointment is especially baneful to chancroids, particularly in their active stage, during which any fatty application is productive only of mischief.

Treatment Subsequent to Cauterization.—Such is the superficial action of carbolic acid when delicately applied that under proper conditions no inflammatory reaction is to be feared. With nitric acid, on the contrary, unless temporary water or lead-water dressings are used, there is a danger of producing subchancroidal and circumferential œdema and cell-infiltration. This is a complication especially to be avoided, since it inevitably retards the cure. It is also very necessary in any case where several chancroids, or even one large one, have been cauterized that the patient should remain in the recumbent position from a half to a whole day.

For chancroids upon the glans and prepuce and in the vulva the interposition of pledgets of lint or of absorbent cotton is necessary. Whatever application is used, these should be changed at short intervals and directly destroyed, preferably by fire. Care must be exercised that the parts be not wounded in changing dressings. In addition, patients should be instructed to very carefully wash the parts, using a little bunch of absorbent cotton with soap and warm water, and then thoroughly immerse them in a sublimate solution (1:2000). For women, too much insistence upon cleanliness is not possible, since they, even the most cleanly of them, are liable to be derelict. They should be instructed to thoroughly and copiously irrigate the vagina several times daily with a mild and hot alkaline solution (borax or supercarbonate of soda ʒss to water ʒlxij), followed by a hot solution of sublimate (1:5000).

The most efficient all-around application to chancroids is iodoform, since it is an undoubted promotor of healthy granulations and a local sedative. It should only be employed in the form of an impalpable powder, either pure or in combination with some bland and absorbent powder, such as subnitrate of bismuth, starch, magnesia, boracic acid, or powdered sugar of milk. Its odor is its great drawback, but even in private practice the expedients of the patient or surgeon may be such that its use does not compromise the former. Various essential oils are mixed with it, but, after all, coumarin, the active principle of Tonka beans, is yet the best disguise. Powdered roasted coffee also is good. When used in powder form the ulcerated surface should be fully but not copiously dusted with it, and over it a thickness of perfumed lint or absorbent cotton may be placed. It may be employed suspended in sulphuric ether (ʒss–ʒj to ʒj) or in similar proportions in glycerin ʒij, aq. ʒvj. I have been unfavorably impressed by its use when combined with vaseline and other fatty bases.

It is important to remember that the action of iodoform is that of producing healthy granulations, and that when this has been effected its use should be suspended, since upon granulating surfaces it often acts by even impeding healing. Further, from these surfaces it is liable to be absorbed and produce toxic effects upon the skin and system at large. The conclusion, therefore, is warranted that the use of iodoform should be suspended when chancroids take on a granulating surface.

It has been claimed that iodol, a preparation containing a large per-

centage of iodine, is equally as efficient as iodoform, and has the advantage of being odorless. Unfortunately, our hopes have not been realized, since this agent is frequently found wanting in test cases. When there is a moderate amount of ulceration its action is fairly as good as that of many old remedies.

Europhen has been used in the treatment of chancroids, and it proves to be mildly caustic and to have healing qualities. It is claimed that, as this drug contains 28 per cent. of iodine, it is better than iodoform, and that it has no odor.

In like manner, the subiodide of bismuth has been vaunted as the substitute for iodoform, In my hands chancroids have crept on, leaving this substance as a deep red crust over the ulcer, while it was very annoying to the patient by reason of the staining of his under-linen.

In the cicatrizing or reparative stage of chancroids, not earlier, much progress is often made by judicious application of a solution of nitrate of silver, 10–20 grains to the ounce, made every few days. The parts are prepared by careful irrigation, then they are dried, and the solution is carefully and sparingly applied.

Aristol is sometimes very beneficial in the treatment of chancroids, but it cannot be depended upon in rebellious cases, as iodoform can. It is very necessary to irrigate the ulcers with the bichloride solution (1:2000), and then dry them before the aristol is applied.

Formalin, used pure or in dilution with water 40 and 10 per cent., has been used in both chancroids and chancroidal buboes. It is said to cause quite severe pain, but to be productive of prompt healing.

The seat of chancroids materially modifies the method of treatment. For those lesions under the prepuce dry powders may be used, and great care must be taken to avoid œdema, for that brings in its train phimosis and paraphimosis, two very annoying and serious complications. On the integument it is often difficult to keep dry powders on the ulcers, in which case watery applications may be used, or powders covered over with lint, cotton, or gauze moistened in water.

At the frænum chancroids are prone to become the seat of œdema, to hemorrhage, to eat through the base of the bridle itself. Therefore they require especial care, particularly as œdema at this region is always followed by phimosis, even if the prepuce is ample.

Chancroids at the margin of or within the urethra must also be carefully treated, and it is well to avoid cauterization, since it is also liable to produce œdema, to cause the ulcers to become more active, and even result in stricture.

If the chancroids are just at the lips of the meatus, they should be well irrigated with a hot bichloride solution (1:2000) or carbolic acid and water (1:250–500). After drying the parts should be covered with iodoform or aristol, and then well bandaged with a mass of absorbent cotton carefully retained.

If the chancroids are about an inch down the urethra, the parts should be first irrigated with the solution just mentioned. Then a No. 12 French catheter, cut off at a length of four inches and lubricated with glycerin, should be passed into the urethra beyond the ulcers, and then by attachment with an irrigator fully a quart of the antiseptic

solutions mentioned should be retrojected. Then iodoform or aristol is insufflated into the urethra, which is packed with absorbent cotton.

Chancroids under the prepuce must be treated after the manner of phimosis plus that of destructive ulceration. Subpreputial injections of hot sublimate solution (1:2000) or of carbolic acid and water (1:150) should be used very often by means of my flat syringe nozzle, taking care to get the irrigating liquid well behind the glans. Then iodoform suspended in glycerin and water should be introduced. It is better in all cases to anticipate gangrene, and if the progress in treatment is not perfectly satisfactory to make two lateral incisions into the prepuce as far back as the glans, which will place all of the affected parts at the disposal of the surgeon. Fears of inoculation of the incisions need give the operator no disquietude.

In paraphimosis complicated with chancroids it is well to refrain from cutting if possible; but if the constriction tends to produce strangulation, the encircling band at the bottom of the sulcus must be cut.

Chancroids in women demand the utmost attention to cleanliness, very much prudence and care in cauterization, and thorough and frequent dressings. Their surfaces should be kept free from all discharges, and all coaptating parts should be separated. In like manner, chancroids of the anus must not be injudiciously cauterized; they should be carefully dressed, the parts being separated. Attention should be paid that the stools be rendered liquid in consistence.

Since the era of violent and indiscriminate cauterization has departed and iodoform has come into use, the ravages of serpiginous chancroids, phagedena, and gangrene are much less common and less severe than formerly.

The treatment of serpiginous chancroids should be both local and general. Wherever there is debility, it is to be combated with nutritious food, tonics, and, if necessary, stimulants. Locally, after prolonged immersion of the parts in water as hot as can be borne and irrigations with 1:2000 hot sublimate solutions, the surface may be touched with nitric acid or bromide and glycerin (1:8), care being taken that the ulcerating furrow at the edge be thoroughly touched. The whole may be temporarily covered with lint or absorbent cotton moistened with dilute Labarraque's solution, 1:10 of water. After this iodoform may be applied quite freely, and the whole surface covered with absorbent or iodoform gauze, over which is a layer of gutta-percha tissue. While this treatment is usually successful, cases do occur which tax the resources of the surgeon and call in play all manner of therapeutical expedients in the way of remedies and methods of application. In some cases the systematic use of the curette, particularly at the margin of the ulcer, produces good results.

Phagedenic chancroids, commonly seen in neglected cases, in ulceration in inaccessible places, and those injudiciously cauterized, and occurring mostly in unhealthy subjects, require the most careful attention to diet, hygiene, and surroundings. The vital powers must be sustained by tonics and stimulants, and opium must be given to relieve the pain and quiet the nervous anxiety of the sufferer. The next essential is to determine whether syphilis is a factor in the process, since in proportion

as that diathesis is active in such cases, so is mercury beneficial; whereas it is positively injurious in simple phagedenic chancroids. I have never seen any benefit result from the use of the potassio-tartrate of iron, which Ricord used to call the "born enemy of phagedena." In this complication of the chancroid the dermal curette may be employed with benefit to remove débris of tissue, sloughs, and pultaceous matter from the surface and edges. Then the whole surface may be thoroughly but carefully touched with nitric acid, with the bromine solution (1 : 3) of glycerin, or with the actual cautery, care being exercised that the surrounding parts are not injured. Phagedena complicating chancroidal phimosis necessitates incisions sufficiently extensive to allow the parts to be reached. In addition to this direct medication, the most important measure is the immersion of the parts or of the whole body in a hot sitz-bath (98° to 102° Fahr.) for from eight to twelve hours a day, care being taken that the comfort of the patient is attended to in every particular. I have seen in my hospital practice the most salutary results from this treatment in very unpromising cases in which the destructive action ceased and reparative action began in from two to thirteen days.

Where the phagedena attacks the distal portion of the penis, irrigations of hot water, of hot sublimate solution (1 : 2000) by means of a spray syringe for several hours a day, have proved very efficacious in my hands. When healthy granulations appear the surfaces may be dressed with balsam of Peru and covered with absorbent gauze.

Hot water of as high a temperature as can be borne is very curative in cases of obstinate chancroids, but it is rendered much more potential by the addition of bichloride of mercury (1 : 2000) and of carbolic acid (1 : 250 or 500). The solutions may be held either in a fountain-syringe or a two-quart rubber irrigator, supplied with a long, thin soft-rubber tube, to which is attached the little nozzle which looks like a miniature water-pot spout, which accompanies most soft-rubber syringes. Thus equipped, the surgeon is prepared for any case, whether phagedenic or gangrenous.

Buboes.

By the term "bubo" we understand an inflammation of a hyperplastic or suppurative character, or both conditions combined, in the ganglia of the inguinal or crural regions.

Inguinal buboes are found in practice in the following forms and conditions: 1, simple hyperplasia of one or more ganglia—mono- and poly-ganglionic adenitis, which may be acute or chronic; 2, suppuration of one, more, or many ganglia and of the ambient connective tissue, while some ganglia still remain in a hyperplastic condition; 3, suppuration of the whole mass of ganglia and the formation of an abscess-cavity; 4, a chronic and mild combined hyperplasia and suppuration of the ganglia and of the connective tissue and skin, which becomes of a dull bluish or purplish color and the seat of sinuses and fistulæ; this is the so-called strumous bubo; and, 5, the chancroidal or virulent bubo, which may follow a chancroid or develop from an ordinary suppurating bubo which has been contaminated by dirt (pus-microbes, perhaps).

Simple hyperplasia shows itself by enlargement of the inguinal

ganglia and swelling of the parts, which may be of normal color or of a more or less deep red. Pain may or may not be present.

When one or more ganglia are the seat of suppuration, and others of hyperplasia, a red and painful swelling is found in the groin, and digital examination shows a combination of fluctuation, doughy sensation, and nodulation. This mixed form of bubo may be as large as an egg or even larger. The true suppurating bubo shows itself by a round or oval, red, and painful swelling which is much elevated and has an area of one to four inches or even larger, its long axis usually corresponding to the fold of the groin.

The so-called strumous bubo shows itself as a circumscribed or irregular inguinal swelling of a dull purplish color, considerably raised above the normal level of the parts and perforated by holes which show both undermining of the integument and the existence of sinuses leading down to inflamed ganglia. The clinical picture is very striking, and gives evidence of a chronic, sluggish, inactive cell-increase and suppuration, the pus of which is thin, sanious, and unhealthy. Patients having this form of bubo are usually persons of poor health and those broken down by excesses or as a result of poverty.

The chancroidal bubo gives evidence from the first of an actively destructive process. The groin becomes red and swollen, and a perceptible tumor is soon developed. The skin becomes red, tense, and the seat of much pain. Redness gives place to a brownish-red tint, and then the swelling, which is considerably salient, presents decided fluctuation. The abscess either bursts from ulceration of the skin or it is incised. The roof of this cavity, which consists of thinned and inflamed skin, then quite promptly melts away and the typical chancroidal bubo-cavity is left. This cavity is usually quite deep, its base is anfractuous, covered with sloughy tissue of a dirty-brown color, over which is a layer of unhealthy pus. The edges of this ulcer (since it really is one) are of a deep red, thickened, and decidedly undermined.

Treatment of Buboes.—Simple hyperplasia of inguinal ganglia may disappear by resolution. In some cases the daily application of tincture of iodine, combined with pressure, will effect a cure. Whenever the patient is particularly anxious for the speedy resolution of the swellings cantharidal collodion may be painted over them. This treatment aided by the recumbent position, is sometimes very effective.

Where there are many ganglia the seats of a low inflammatory process which has not progressed to suppuration, resolution may be induced by injections of carbolic acid, according to the method of Dr. M. K. Taylor, who advocates the use of interstitial carbolic-acid injections in buboes and inflamed lymphatic ganglia generally. He injects from ten to forty minims of a watery solution of the agent of a strength of from eight to ten grains to the ounce. When used before the formation of pus he claims that he has not failed to arrest the morbid process. When pus has formed he evacuates the abscess by aspiration and throws in the carbolic solution. When the abscess-cavity is small he evacuates the whole of the contained pus; if large, only a part, and then throws in sufficient of the fluid to take its place. When spontaneous opening has occurred, the cavity has to be washed out with the same fluid and compression applied. Care is to be used to reach the centre of the tumor,

and according to the author the needle should be thrust to the extent of two-thirds of the depth of the narrowest diameter of the tumor. The method has been used by him for seven years in nearly one hundred and fifty cases. It is claimed that by this method pain is much relieved, and very little loss of time is incurred. Interstitial carbolic injections have sometimes been followed by surprisingly satisfactory results at my hands.

A method of treatment in the same direction—namely, the injection of an antiseptic solution—has recently been advocated by Welander. His solution is made as follows: Benzoate of mercury, 1.0; chloride of sodium, 0.3; and distilled water, 100. Of this liquid one or more Pravaz syringefuls are injected into the most prominent part of the tumor. Welander claims great success for this treatment, and he is endorsed by Spietschka, who gave it a good trial, which was followed by satisfactory results.

In all cases when these injections are made the parts must he rendered aseptic, and great care be exercised in the technique of the injection.

When abortive measures fail in cases of inguinal ganglionic hyperplasia it is well not to temporize, but to resort at once to the radical operation of total extirpation. The operative field is shaved and rendered surgically clean; then a long, free incision is made parallel with Poupart's ligament and over the most prominent part of the swelling. It may be necessary also to make a vertical incision in order to have more space to work in. This vertical incision may be of advantage in drainage. When the parts are exposed all the glands, even if they are seemingly healthy, are to be dissected out. In this operation the surgeon may have to go down to and even between the femoral vessels. He should therefore work slowly and cautiously, taking out the ganglia with the handle of the scalpel or by means of his finger-nails. Parts should never be violently torn. The ganglia will be found to be firm oval masses as large as a bean and larger, and will be readily recognized when the operator has become a little familiar with the operation. All bleeding vessels must be tied. The wound when finished must be saucer-shaped, and should be well irrigated with 1 : 2000 bichloride solution. It is then packed with iodoform gauze, over which absorbent cotton and layers of bichloride gauze are held in place by a spica bandage. In some cases the conformation of the parts is such that the edges of the wound may be stitched together and the attempt may be made to obtain primary union.

Suppurating buboes may be treated by the old-time method of incision, followed by antiseptic irrigation and careful packing. The disadvantages of this method are that a long time is required in the healing of the parts, the dressings cause pain, and a compromising scar is left.

Within the past decade a method of treating suppurating buboes has been proposed and perfected, which I have no doubt will in a great measure replace all others. The active agent in this treatment is iodoform thrown into the abscess-cavity. The technique of the operation is as follows:

1. The operative field is shaved and rendered surgically clean. 2. A few drops of an 8 per cent. solution are injected beneath the skin where

the puncture is to be made. 3. A straight, sharp-pointed bistoury is thrust well into the most prominent part of the mass until pus flows. 4. All of the pus is forced out through this opening by firm but gentle pressure, as the procedure is, as a rule, very painful. 5. The abscess-cavity is irrigated with pure peroxide of hydrogen until it returns practically clear. 6. It is then irrigated with 1 : 5000 bichloride-of-mercury solution, all of which is carefully squeezed out. 7. The now thoroughly cleansed abscess-cavity is completely filled with 10 per cent. iodoform ointment by means of an ordinary conical glass syringe previously warmed in hot water, and a finger held over the puncture until— 8. A cold wet bichloride dressing is applied with a fairly firm spica bandage. The cold congeals the ointment at the puncture, and thus prevents its escape into the dressing.

The patient should be kept very quiet for the first twenty-four to forty-eight hours, in bed if possible, although this is not absolutely necessary. The dressing should be changed at the end of three or four days. It is not often necessary to repeat the process of irrigation, cleansing, and injection.

Though it has been claimed that buboes are cured by this method in six or eight days, the time occupied is usually between ten and twenty-one, which may be said to be an excellent showing. Besides this advantage, there is no necessity for painful applications or dressings, and the scar left is usually so small that it is necessary to look for it very closely in order to find it.

The treatment of the so-called *strumous buboes* should be radical and thorough. The parts are shaved and rendered as nearly as possible surgically clean. Then a long free incision in the course of Poupart's ligament is made, and, if the bubo is large, is crossed at its middle by a smaller ventrical incision. Then the ganglia and the affected tissues are carefully but thoroughly removed in the manner already described. All the bluish, thickened integument should be cut off with the scissors, and care should be particularly exercised that any sinuses in the skin should be exsected. The wound is then antiseptically treated.

Dr. F. S. Watson claims that by means of excision and most thorough antiseptic measures he has been able to get union by first intention in ten out of twenty unselected cases of buboes of all kinds, in all but four of which the overlying skin was inflamed, and in some necrotic. The following rules were followed: 1, to remove all diseased tissue, and to leave as far as possible a perfectly healthy surface in every part of the wound (to secure this it is always necessary to carry the dissection down to the fascia covering the abdominal muscles; sometimes to expose the femoral vessels, and generally the external inguinal ring); 2, to excise such portions of the skin as threatened to become necrotic or had already become so; 3, to curette the under surface of the skin-flaps; and, 4, to thoroughly swab the whole wound with dry sterilized-gauze sponges or with sponges wet with a solution of corrosive sublimate, 1 : 4000.

In carrying out this operation Watson makes a crescentic cut, "carried well below the area of inflamed skin through the healthy skin. From this line a flap is dissected up, extending to a line well above the diseased glands and exposing them thoroughly. After their removal the flap is turned down and its edge sutured on the line of the first incision."

Drainage may be made by means of sterilized strands of silk, passed through the opening below the line of the incision. The second incision used is a long one parallel with Poupart's ligament, and an elliptical piece of skin corresponding to the site of the ganglia is dissected off, and then the edges of the wound are sutured.

It may be said of this radical operation that it will certainly leave very large and very much depressed scars, corresponding to the amount of tissue which is removed. It has been found in this method, moreover, that the suppurating process sometimes burrows away from the part operated on, and that a very severe condition of abscess is produced.

Chancroidal bubo may in its early stage, when suppuration has taken place and when the skin is not much involved, be successfully treated by the iodoform-vaseline method, which will sometimes bring about a cure even when the skin is thin and reddened. This treatment should always be used in appropriate cases of chancroidal bubo.

If in this form of suppurative adenitis the skin is much destroyed, particularly if perforation has occurred, the long inguinal incision should be made under most rigid antiseptic conditions, and the abscess-cavity should be thoroughly cleansed by curetting, by the removal of all diseased ganglia, and by the copious irrigation of hot bichloride solution, 1 : 2000. The wound should then be dusted with iodoform and packed with gauze well covered with gauze and absorbent cotton, and the whole should be well retained by a spica bandage. In these cases it may be necessary to remove the dressing and to freely irrigate the wound with the bichloride solution once or perhaps twice a day. When granulations begin to appear, balsam-of-Peru gauze may be used instead of iodoform dressing.

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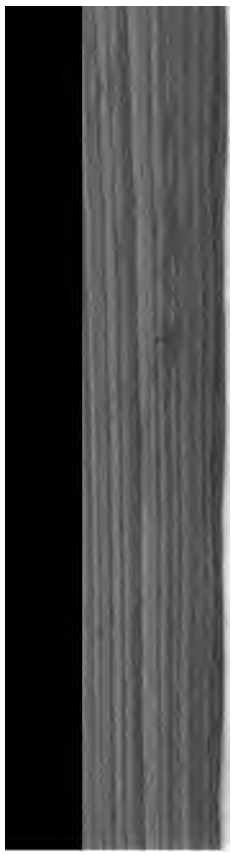

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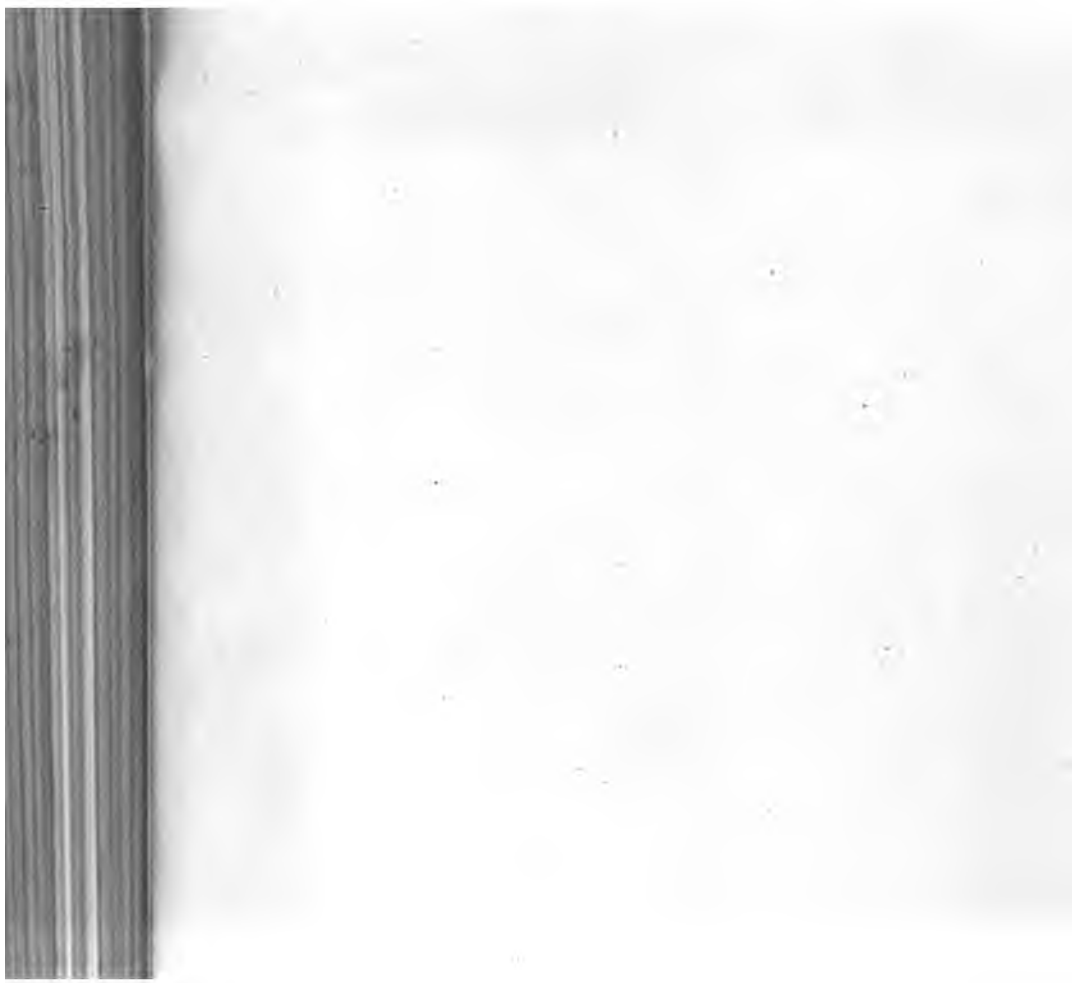

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